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THESIS

AN ANALYSIS OF FACTORS AFFECTING
PROMOTION, RETENTION, AND
PERFORMANCE FOR USMC OFFICERS: A
GRADUATE EDUCATION PERSPECTIVE

by

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March, 1996

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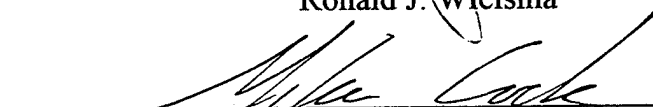
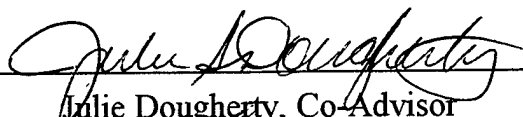## NAVAL POSTGRADUATE SCHOOL
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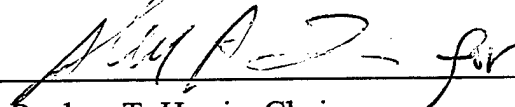
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ABSTRACT

This thesis analyzes the factors associated with promotion to O-4, retention to the O-4 promotion point, and actual performance ratings. One factor, graduate education, is specifically targeted for detailed analysis to determine its direct effects on the measures of on-the-job performance. A Defense Manpower Data Center (DMDC) cohort file of USMC officers who were commissioned during fiscal year 1980 is merged with Automated Fitness Report System (AFRS) files and Headquarters Master File (HMF) information to analyze performance differences between officers who have and have not obtained a postgraduate education. Nonparametric, ordinary least squares (OLS), and non-linear maximum likelihood (PROBIT) techniques are used to estimate the selection, retention and promotion models. The results suggest that actual on-the-job performance is an important factor in determining promotion, retention, and who attends graduate education. Graduate education appears to have a positive effect on promotion; however, failure to correct for retention and selection issues biases the estimated effects of graduate education upward. Further study using more sophisticated techniques is recommended to clarify the interrelationships among promotion, retention, performance, and graduate education to gain more information on the magnitude and direction of these potential biases.

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I. INTRODUCTION

A.   INFORMATION

One of the objectives of the United States Marine Corps (USMC) has always been to train and retain quality personnel, both officer and enlisted, to achieve a more effective fighting force.   Currently the Manpower and Reserve Affairs (M&RA) portion of the fiscal year 1996 USMC budget, the part which supports the pay, allowances, and all other manpower-related programs for all USMC personnel, is 75.2 percent of 9.5 billion dollars (Justice, 1995). With such a large portion of the budget consumed by manpower, the Marine Corps has increased scrutiny of existing programs and policies in an attempt to reallocate funds for operational requirements. Recent force structure reductions are a clear example of this trend, and it is likely that future reductions will be taken out of the manpower force, either by terminating programs, changing costly policies, or cutting additional structure. Thus, any research devoted to identify individual independent factors which contribute to better performance, better retention, and higher probabilities of promotion, while at the same time maintain or increase operational effectiveness could greatly assist in increasing the quality of the force. Ideally, these same factors will also achieve cost savings and maximize military effectiveness.

One such independent factor is education. General Krulak, the 31st Commandant of the Marine Corps, stated in his planning guidance that

> ...education is the foundation for a Marine Corps that can anticipate and adapt
> to the changing world that we are entering. Training and education must lead
> to better, more effective, more adaptable Marines. (Krulak, 1995)

The question remains, however, as to whether or not current educational programs and policies are leading to better, more effective Marines -- or whether better Marines are simply taking advantage of education programs offered to them. Additionally, there is a question of whether these Marines are exiting the Marine Corps for better jobs in the civilian sector once they take advantage of those educational programs. This thesis will examine one piece of this larger issue -- graduate education for Marine Corps officers. For the purposes of this thesis, a 'better, more effective' Marine Corps officer is defined as an officer who is more likely to be promoted (as per promotion board results), one who is more likely to remain on active duty, and one who is a better performer (as per fitness report documentation).

B. BACKGROUND

Many studies have been conducted which examined individual characteristics, including graduate education, affecting promotion, retention, and performance. Most of these studies were performed independently, were focused on a specific policy or issue, and were limited by availability of data for analysis. Each study attempted to create statistical models useful in predicting either promotion or retention behavior and to improve the overall manpower process. This research combines the elements of those studies, focuses on the policy of providing graduate education to Marine Corps officers, and uses longitudinal data to allow for examination of possible trends over time.

Several important points must be addressed regarding Marine Corps officers and their career paths. All candidates for commission, regardless of their source, must first attend Officer Candidate School (OCS). OCS is the first experience an individual has with life as a Marine Corps officer, and the training program is ultimately designed as a selection

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instrument to test an individual's desire. Those who complete OCS are then eligible for commissioning once they complete their undergraduate degree, if not completed already. The next step, once commissioned, is the Basic School (TBS). TBS is a six month training program which all Marine Corps officers must attend. The training is designed to ensure that all Marine Corps officers have the basic skills to perform adequately as infantry platoon leaders. Officers are tested on their military, academic, and leadership skills, and these scores are combined into a single score, then officers are ranked from best to worst. The officers are then categorized into three groups based upon their ranking, and military occupational skills (MOS's) are then distributed equally among each third to ensure a 'quality spread' of officers across occupations. Upon graduation, the officers then attend their MOS school and are sent to their first assignments in the Fleet Marine Force (FMF).

After the initial assignment, an officer's career can take many different directions, but there are linking factors which may contribute to success. Generally, the second assignment is in a non FMF billet such as recruiting duty, independent duty, or duty with a Marine Corps Base activity. By the third assignment, the officer has normally achieved the rank of captain (O-3) and usually returns to an operational command in the FMF within his or her occupational specialty. Then, once an officer becomes eligible for promotion to major (O-4), some sort of headquarters staff assignment is most likely. By the time an officer reaches the major (O-4) promotion point, at least four different assignments have been completed. The linking factors in officer assignment patterns are the amount of time an officer has served in positions requiring their MOS, considered MOS time, and the amount of time an officer has served in operational units, considered FMF time. Conceptually, more time spent in one's

MOS and in the FMF ensures that an individual officer is fully trained and qualified to perform successfully in an operational environment, which is arguably the Marine Corps' primary purpose.

During any assignment phase, an officer can potentially achieve a graduate education. There are several possible ways to obtain a graduate education while on active duty in the Marine Corps. An officer can apply for the Special Education Program (SEP) or the Advanced Degree Program (ADP) and receive a fully funded graduate education at the Naval Postgraduate School (NPS), the Armed Forces Institute of Technology (AFIT), or a civilian university. These officers incur an additional four years of service commitment to repay the cost of the fully funded education, and these officers generally serve in specialized billets designated for their graduate degree. A second option is for an officer to pursue a graduate degree on his or her off-duty time while stationed near a postgraduate facility, generally a civilian university. These officers can receive tuition assistance which covers up to 75 percent of the cost for each class. The officer then incurs an additional obligated service of two years from the date of completion of the course of instruction for which monetary benefits were received. These officers generally are not assigned to specialized billets after receiving their degree.

Since the graduate education choice is possible at any point in an officer's career, it is essential to include those variables that effect an officer's career in any analysis of the effects of graduate education on performance. Either of the two possible means of obtaining a graduate education definitively impact an officer's retention behavior. Those officers who choose graduate education may be more likely to separate, but end up remaining on active

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duty for the perceived added value of a graduate education. Potentially, retention and graduate education interact with each other such that on-the-job performance measures appear to be positive while in essence they have a negative impact on performance.

C.   PURPOSE AND INTENT

The principal purpose of this thesis is to assess whether or not Marine Corps officers who have obtained a postgraduate degree since their initial commission have a higher performance level than their peers. This question will be analyzed through the use of multivariate models using the performance measures of retention and promotion to the grade of major, usually reached between the tenth and twelfth year of service (DOPMA, 1980). An actual on-the-job performance measure of fitness report markings will be used as an independent variable, since promotion and retention are outcomes of actual performance and not pure measures of performance. Promotion, retention, and performance, as well as graduate education, quite possibly interact with each other; not modeling selectivity or possible effects of omitted variables could produce significant biases in the estimated effects of variables in the theoretical models formulated, making them invalid for use in predicting the future or in accurately conducting a cost benefit analysis. If, for example, a large percentage of officers with graduate degrees separate before ever being eligible for promotion to major, and these officers had a significantly higher level of performance and a higher predicted probability for promotion than their peers, then there is a clear indication that more qualified officers are separating. If this retention behavior and its effect on sample truncation is modeled, more accurate estimates of the independent effect of graduate education can be obtained.

D.   ORGANIZATION OF THE STUDY

Hopefully to this point the reader has been informed as to why manpower and personnel programs are under scrutiny and the necessity, within the manpower arena, to conduct analyses to improve the quality of the force. Chapter II presents a review of the relevant literature on performance measurement and how graduate education has been used as a measure of performance. Furthermore, a discussion of how bias could be introduced into a study and its possible impact on the estimated effects of graduate education is provided. Chapter III describes the data used in this study and the samples created for statistical examination. Additionally, the theoretical basis for the variables included in the statistical models will be discussed. Chapter IV presents the non-parametric results of the data analysis. Cross-tabulations and statistical tests are provided to inform the reader as to the general characteristics of the data and the simple nature of the relationship between the variables analyzed. Chapter V presents the method of statistical analysis used for the multivariate models, provides the results of those models, and discusses the independent effects of certain personal and professional characteristics, especially graduate education, on the dependent measures of performance. And finally, Chapter VI summarizes the findings of this study, whether or not graduate education increases performance, and provides recommendations for future research efforts.

II. LITERATURE REVIEW

A.   MEASURES OF ON-THE-JOB PERFORMANCE

Interest in identifying any individual characteristics which increase on-the-job performance or 'quality of the work force' is not new or unique. Wise (1975) first analyzed the effect of ability and college background on salary growth and promotion probability in the civilian sector. In doing so, he formulated a theoretical on-the-job performance model which is the basis for this research. His model states that performance measures are a function of cognitive skills, affective traits, and demographic characteristics. He found that personnel in professional managerial positions with masters of arts degrees had a higher annual salary growth rate and a higher promotion probability than their peers without graduate education.

Further civilian studies conducted by Medoff and Abraham (1980; 1981) and Woo (1986) also analyzed the effects of graduate education. They, too, found that graduate education had a positive effect on salary levels. They did not, however, come to the same conclusions as Wise. Medoff and Abraham concluded that earnings were higher for master's degree holders due to their initial entry into the labor market at a higher wage rate. Woo concluded that since graduate education did not increase job evaluation levels or probability of promotion, graduate education may not improve on-the-job performance. Neither of these two studies addressed the potential self-selection bias imposed by the fact that promotion is dependent on the individual's retention decision. Clearly, an individual that chooses to leave the firm prior to a given promotion point is no longer observed, although past performance may predict that the individual would be promoted. Graduate education could be an

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important factor in both the retention decision and the promotion outcome or the salary growth rate.

On-the-job performance measures used in these civilian studies are comparable to those available in the military. Since the theoretical model developed by Wise is broad enough to be applied to the military, the remainder of this section will review pertinent literature as it pertains to the military on the three dependent measures of performance which are the foundation of this study: Promotion, retention, and actual performance ratings as measured by the USMC fitness report.

1. Promotion

Promotion to the next higher grade has often been used as a proxy for indicating a military officer's performance. Cymrot (1986) was the first researcher to focus on the effects of fully funded graduate education on promotion in the military. Using a cross-section of all Navy officers on active duty in 1985, he found that graduate education significantly increased the probability of promotion to lieutenant commander by 26 percent. In his statistical model, he attempted to control for the self-selection bias of a more motivated or intelligent individual possibly choosing oneself for graduate education by including a control variable for those officers who were promoted earlier than their peers. He concluded that

> improved promotion rates, however, are only one component of the marginal benefit [of graduate education]; the other components are increased productivity within rank and increased retention. Before assessing the overall efficiency of graduate education in the Navy, it is necessary to estimate the magnitudes of these effects. (Cymrot, 1986)

Talaga (1994) also analyzed the relationship of fully funded graduate education on the probability of promotion to Lieutenant Commander in the Navy. Rather than controlling for

selection bias using early promotion as an indicator, Talaga obtained actual fitness report data and merged it with the Navy Officer Master File. He then used the recommendation for accelerated promotion (RAP) as a performance measure and included RAP in his probit selection model to estimate the impact of performance on the likelihood of being selected for fully-funded graduate education. He then included the graduate education variable in the second stage of his promotion model to control for selection bias. By controlling for selection bias, he found that the likelihood of promotion only increased by 13.6 percent, as compared to the 26 percent reported by Cymrot.

In an attempt to clarify the extent graduate education enhances on-the-job performance for USN officers, Mehay and Bowman (1995) conducted a bivariate probit analysis using the on-the-job performance theoretical model developed by Wise. As independent variables, they constructed a performance measure comprised of the percentage of fitness reports in pay grade O-3 containing a RAP. As cognitive skills, they used college Grade Point Average (GPA), type of major, and whether or not a Master's Degree had been obtained. They used source of commission as their only affective trait and included race, sex, age, and marital status as their demographic characteristics. Their bivariate probit specification modeled the decision of Navy unrestricted line officers on active duty from 1980 to 1994 whether to participate in graduate education or not and that decision's effect on promotion outcome. By using bivariate probit, they were able to control for the selection bias of the choice to attend graduate education. They, like Talaga, found that graduate education has a positive effect on the promotion outcome, but when controlling for selection bias, the estimated coefficient of the graduate education variable is significantly reduced. They

concluded that

> graduate education has direct effects on measures of job performance, those effects are independent of ability and prior performance, and additional human capital (both specific and general) does enhance productivity. (Mehay and Bowman, 1995)

Since their data was a pooled cross-section, they recommended that future research be conducted to include examination of the selectivity bias introduced by the separation decision and to examine cohort data which would allow for analysis of possible career pattern effects on graduate education.

Similar studies have analyzed the effect of graduate education on officer promotions in the USMC. Long (1992) examined all officers in the primary promotion zones to the grades of O-4, O-5, and O-6 for fiscal years 1986 through 1992. While not focusing his research specifically on the impact of graduate education, he did include an independent variable for an advanced degree holder. For promotion to O-4 and O-5, having an advanced degree significantly increased the probability of promotion. Unfortunately, the data used did not include a performance measure, and Long did not control for selection bias based on the graduate education selection decision.

One study of USMC officers which did focus on the effect of graduate education on promotion was conducted as a Master's thesis at the Naval Postgraduate School (NPS) by Major David Estridge (1995). Rather than focusing on the effect of all types of graduate education, he examined the effect of a degree obtained at NPS. He obtained fitness report data on those officers in the promotion zone to the grades of major and lieutenant colonel for fiscal years 1993 and 1994. By using a constructed performance index as an explanatory

variable, he was able to control for the self-selection bias based on choosing graduate education, and he, too, found that officers with an NPS postgraduate degree are more likely to be promoted to major or lieutenant colonel than officers who are non-NPS graduates. A unique finding in his study was that the difference in promotion rates was even more distinct if the subject matter studied matched with an officer's occupational specialty, suggesting that specific graduate education has a greater effect on performance than general education. Unfortunately, since his data was a cross-section of only active duty officers in zone for promotion, he was unable to determine what effect, if any, graduate education had on retention.

2.   Retention

Since the focus in the military today is to increase the quality of the force while reducing manpower costs, retaining the most qualified officers is paramount. The decision to stay or leave is primarily an individual decision, not an organizational one, so it is important to take into account the individual characteristics which lead to higher predicted retention. Then, it is necessary to examine those same characteristics using other performance measures to analyze retention policies as they could effect the ultimate effectiveness of the force. Schmidt (1982) analyzed the career orientation of junior USN officers using data from a 1978 Rand Corporation survey. He concentrated on officers with more than two but less than 10 years of service. He found that the most important factor in an individual's decision to stay in the military was the individual's overall satisfaction with Navy life. The individual's general feelings towards his job and organization were next in importance. These general sentiments also apply to USMC officer retention decisions. Marine Corps officers interviewed as part

of another study,

> ...felt that promotion potential was a major factor when determining whether to remain on active duty or leave the service. Further, they felt that a high promotion potential would indicate satisfaction with the service while a low promotion potential would cause an officer to resign his commission. (Esmann, 1984)

Theilmann (1990) analyzed Marine Corps officer separation behavior for officers in their initial period of obligated service using information contained in the 1985 DOD Survey of Officer and Enlisted Personnel matched with data obtained from the Defense Manpower Data Center. He analyzed the effect of intrinsic and extrinsic job satisfaction factors, satisfaction with benefits, current location, and community attitudes on the stay or leave decision. He concluded that

> the factors which most strongly influence male junior officers to remain on active duty beyond their initial service obligation are their commissioning source, marital/dependent status, military occupational specialty, and intrinsic and extrinsic job satisfaction factors. (Theilmann, 1990)

While his model was statistically significant, he was not able to make any conclusions about retention decisions as they occur over time, since his data was cross-sectional.

Steele (1987) also examined retention using data obtained from the 1985 DOD Survey of Officer and Enlisted Personnel, but he expanded his retention question to include Marine Corps officers with four to twelve years of service. Using a question from the survey which provided an officer's intended length of service, he categorized individuals as careerists (those who indicated they would serve more than 20 years in the military) and noncareerists (those who indicated they would separate prior to reaching 20 years of service). Trying to accurately predict an individual officer's retention decision, he concluded that

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potential non-careerists are more accurately identified by using the mean value of the predicted probability of being a careerist as the cutoff point. Otherwise, it would be easier to just assume that everyone is a potential careerist. (Steele, 1987)

He did include education as an independent variable in the retention model, but found that education was not statistically significant for either careerists or non-careerists. These findings are important for two reasons in this research. First, those factors necessary to predict whether an individual officer is a careerist are critical to specifying a model for non-careerists. Second, the contradictory results of the value of education raise doubts as to the validity of self-reported cross-sectional data for determining separation behavior of an individual at a future point in time.

Further research which validates the need for longitudinal rather than cross-sectional data in retention studies was conducted by Hamm III (1994). Using a completely non-parametric approach, he examined differences in success or failure at three successive career steps for Marine Corps officers: The Basic School (TBS), selection to captain, and selection to major. While his focus was on differences in success and failure rates between racial/ethnic groups, his analysis included evaluation of the effects of marital status, commissioning source, and occupational field, and he was able to examine differences over time since his data was longitudinal and included all officers who entered the Marine Corps from 1980 to 1991. He found significant differences between cohorts in all variables. "The implication is that 'when' an officer enters the Marine Corps has a significant impact on success [or failure]." (Hamm III, 1994) Thus, retention studies must involve data which allows for examination of individual characteristics at various points in time, rather than at only one moment.

Unfortunately, Hamm III did not examine graduate education, but his work resulted in a subsequent Master's thesis at the NPS prepared by Lieutenant Brian Miller (1995) on the estimated effects on minority officer retention behavior based on the recent drawdown in manning levels. He theorized that officers in the Marine Corps reach three key decision points in their careers, between entry and the fourth year which coincides with the end of the initial obligated service and includes early attrition, between the fourth and twelfth year which coincides with the promotion point to O-4 (truly the career decision point) and includes early separations in the period, and between the twelfth and nineteenth years which coincides with the late leave decision and early retirement window. He first used a log-linear survival model to examine the average months in service of officers with different personal characteristics, then used a non-linear logistic regression equation to predict the probability of separation. While his primary focus was on minority officers, his models did include a postgraduate degree variable which significantly increased the probability of staying for all three phases. Marine Corps officers with postgraduate education were more likely to survive to each decision point and were less likely to separate during any of the three phases. He was not, however, able to obtain performance data for his study which should be an important factor in an individual's retention decision as determined by Schmidt and Esmann earlier in this section. Those individual's with a lower average performance could potentially forecast that their opportunity to be promoted is lower, be less satisfied with military life, and choose to leave the service.

North and Smith (1993) also did not evaluate a performance indicator in their study, but they were able to control for selection bias caused by the retention decision. In their

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analysis of promotions to captain and major in the USMC, they used a longitudinal file of all Marine Corps officer accessions from fiscal years 1980 through 1991. They were able to conclude that different accession characteristics were important in predicting promotion to captain as compared to promotion to major. Additionally, they were able to show that by controlling for the retention decision, differences between promotion rates between population subgroups were significantly reduced, validating the technique used. Unfortunately, their analysis only pertained to accession characteristics which did not include education level.

3. Performance Information

Promotion and retention are simply observed outcomes of an individual's performance and may not be as useful in predicting the true effects of graduate education on on-the-job performance. Thus, a more precise indicator of performance which should be an independent variable in a promotion or retention model is necessary. One such indicator is the Marine Corps performance appraisal system which includes a requirement for an individual's immediate supervisor to quantitatively, although subjectively, assess the Marine's actual on-the-job performance on a recurring basis. When fitness report data first became available, most research was conducted on retention behavior, principally due to the theoretical belief that one's perception of promotion potential is linked to intrinsic job satisfaction and a key element in the retention decision. A rudimentary performance index was created in 1984 as an attempt to capture actual on-the-job performance for use as an independent variable in manpower models to explain Marine Corps officer attrition (Esmann, 1984). Using logistic regression with the stay or leave decision as the dependent variable and the performance index

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as an independent variable, he found that the performance index could not reliably predict an officer's likelihood of attrition. Based on the results, the author concluded that it was necessary to add a job assignment variable as well as an occupational specialty variable. The author hypothesized that the performance index may be higher for people in non competitive military occupational specialties (MOS's), and may be lower for people in better jobs. He did not include education as a variable in his model specification.

In a follow on study conducted by Stephen Hurst and Thomas Manion (1985), additional factors determining the stay or leave choice were modeled. They included the military-civilian pay ratio, the unemployment rate, and a performance index as variables in the model. They examined data on every Marine Officer on active duty from 1977 to 1984, created a performance index score by summing individual fitness report markings and dividing by the individual's total number of reports. They used logistic regression analysis to determine the predictability of attrition. While they were able to predict within 90 percent accuracy the following year's actual attrition, they were not able to accurately predict any subsequent years with accuracy. Education was also not included as a variable in their model specification.

B.   TYPES OF BIAS

Up to this point the term 'selection bias' has been used frequently in general terms to indicate possible shortfalls in the previous studies cited. Before continuing, it is necessary to completely define the potential types of bias with respect to obtaining postgraduate education, remaining in the Marine Corps, and being promoted as they pertain to this study.

> Selectivity concerns the presence of some characteristic of the treatment (or control) group that is both associated with receipt of the treatment and associated with the outcome so as to lead to a false attribution of causality regarding treatment and outcomes. So stated, selectivity bias is a version of omitted-variable bias, which is commonly analyzed under the rubric of specification error in econometric models. (Barnow et al., 1980)

Other forms of bias include "inclusion of an unnecessary variable, ...adopting the wrong functional form, ...[and] errors of measurement." (Gujarati, 1995) Each form of bias ultimately results in an upward or downward effect on the coefficient of the variable being analyzed. We have seen that controlling for the selection bias involved with graduate education significantly reduces the independent effect on the probability of promotion (from 26 down to 13 percent). This potential selection bias for choosing graduate education will be controlled for by introducing a selection equation. Another selection equation will be introduced to control for the potential selection bias of choosing to stay or leave the military. Obviously, if a high quality performer decides to separate prior to a given promotion point, then promotion as an outcome of performance is not accurately reflected unless the retention decision is controlled for.

Three other potential biases, forms of omitted relevant variable bias, will also be examined. First, a potential bias from choice of source will be examined by inclusion of commissioning source control variables in the multivariate models. Different types of individuals apply for and are accepted to different commissioning programs. Hypothetically, those individuals who apply for the Naval Academy may be higher quality than those individuals who simply attend OCS after graduating from college. Also, a potential bias from occupational assignment will be examined by inclusion of occupational category control

variables. Perhaps performance is a function of what value particular occupations have within an organization rather than how well an individual performs within his or her occupation. Finally, the potential bias for an individual's taste and preference for military life will be controlled for by including the ranking at TBS as an independent variable. On average, those officers who graduate in the top of their TBS class have a greater taste for life as a Marine Corps officer than those who graduate at the bottom. The specific variables used in this research and an explanation of the method of analysis employed to account for these biases will be explained in detail in Chapters III through V.

III. DATA COLLECTION

A.   THE DATA SOURCE

The core of the data used in this study are drawn from the Defense Manpower Data Center (DMDC). Further information was drawn from the Marine Corps Automated Fitness Report System (AFRS), the Headquarters Master File (HMF) and the Official Military Personnel File (OMPF). Marine Corps specific data was obtained from Headquarters, U.S. Marine Corps (MA) located in Washington, D.C. All sources were merged into one file for analysis. Each unit of observation is an individual officer who accessed into the USMC during fiscal year 1980. Each record has an annual update of each variable through fiscal year 1994 and thus constitutes a cohort file which allows for longitudinal evaluation. A comprehensive listing of the dataset variables and their definitions are provided in Appendix A for use in any follow-on studies. Specific variable names and their descriptions which are of substantive use in this analysis are included in Table I on the following page. Grouping the variables by categories as defined by the on-the-job performance model facilitates describing the model specification and the choice of the variables for analysis. A high quality officer has already been defined as one who chooses to remain in the USMC, one who is promoted, and one who has a higher performance average than his or her peers. The construction of the STAYPROM and PROMOTE variables is self-explanatory, but the creation of the AVGPI variable requires further explanation.

The construction of a performance index was first outlined by Haffey (1986) and validated by Arnell III (1988). Arnell III studied the relationship between fitness report

Table I. Variable Abbreviations and Their Descriptions Grouped By Qualitative Category

VARIABLE	DESCRIPTION
Performance Measures	
STAYPROM	= 1 if stayed to the O-4 promotion point; 0 otherwise
PROMOTE	= 1 if promoted to O-4; 0 otherwise
AVGPI	= the average performance index for an officer's entire career
Cognitive Skills	
GCT	= General Classification Test score taken on entry
COMPRK	= Composite ranking at the Basic School
OBPGRAD	= 1 if obtained a postgraduate degree since entering the Marine Corps
Affective Traits	
ROTC	= 1 if Reserve Officer Training Candidate source; 0 otherwise
ACADEMY	= 1 if Naval Academy source; 0 otherwise
OCS	= 1 if Officer Candidate School source; 0 otherwise
ENLCOM	= 1 if commissioned after serving previously as an enlisted member of the Armed Services; 0 otherwise
PLC	= 1 if Platoon Leaders Class source; 0 otherwise
COMBAT	= 1 if in a combat arms related MOS; 0 otherwise
SERVICE	= 1 if in a service related MOS; 0 otherwise
SUPPORT	= 1 if in a ground support related MOS; 0 otherwise
AIRSUP	= 1 if in an aviation related support MOS; 0 otherwise
PILOTS	= 1 if either a fixed or rotary wing pilot MOS; 0 otherwise
RESERVE	= 1 if received a reserve commission on entry; 0 if received a regular commission
Demographic Traits	
AGE	= Age at Entry (1980)
MINORITY	= 1 if from minority population group; 0 otherwise
FEMALE	= 1 if female; 0 otherwise
MARRIED	= 1 if ever married through separation or present date; 0 otherwise
UNEMP	= the general civilian unemployment rate for each year

scores and selected characteristics of Marine Corps Officers and found that the performance index was statistically significant in identifying individual characteristics which contributed to an average higher performance. The performance index is the best available measure of on-the-job performance, because in section B of the fitness report, Marines are quantitatively marked on a scale (not observed=N, unsatisfactory=0, below average=1, average=3, above average=5, excellent=7, and outstanding=9) on twenty two professional and personal characteristics. These characteristics are divided into three categories of performance, qualities, and overall value to the service. The individual scores are summed, then the total sum is divided by the number of observed marks to attain an average for each report. This study will compute the performance index slightly differently. Each individual officer receives a fitness report on at least an annual basis, so this study sums the average of each report, then divides by the total number of reports received by each individual over the course of that officer's career. We would expect that average performance would increase over time as the level of work experience increases, just as we would expect that the variance in the average performance of the sample would decrease as officers with lower performance averages separate from the Marine Corps. The focus of this study is to determine whether the average performance of those with graduate education is significantly higher than of those who have not obtained a postgraduate degree. The remainder of the variable groupings and their expected effect on the measures of performance will be discussed in the next three sub-sections.

1. Cognitive Skills

The GCT score ranges from 0 to a maximum of 150 and is very similar to other intelligence measures such as the Scholastic Aptitude Test. The minimum score required for entry is 120, but waivers are allowed so some values may be lower. We would expect that a higher GCT would lead to a higher probability of promotion to O-4. Similarly, we would expect that an officer's COMPRK at the Basic School would directly impact on an officer's level of performance over time. This variable should not only measure an officer's level of cognitive ability, but also his or her taste and preference for military life. Those who show signs of disinterest while at TBS generally tend to be ranked lower than their more interested peers who are ranked higher.

Level of education (OBPGRAD) is the focus of this research and to this point, the literature indicates that graduate education increases an officer's probability of promotion and probability of staying on active duty. Labor economic theory on education, as it applies to the overall labor market, states that:

> 1. Average earnings of full-time workers rise with the level of education;
> 2. The most rapid increase in earnings occurs early in one's working life, thus giving a convex shape to the age/earnings profiles of both men and women;
> 3. Age/earnings profiles tend to fan out, so that education-related earnings differences later in workers' lives are greater than those early on. (Ehrenberg and Smith, 1994)

In the military, however, it does not make sense to compare earnings differences by education. It is an internal labor market, i.e., all officers enter the Marine Corps as second lieutenants and progress through the system at the same pace. Rarely, if ever, are there accelerated promotions in the USMC, and the military's 'up or out' philosophy is designed to

ensure that lower performers must separate. The question remains, though, as to how many high performers are choosing to separate. We should expect in the military that OBPGRAD increases the likelihood of both retention and promotion, and that the average performance of those with graduate education is higher than those without additional education.

2.   Affective Traits

Labor economic theory states that there are wage differentials by occupation. An occupational distribution exists which pays higher wages for executive, managerial, administrative, and professional jobs and lower wages for operators, handlers, laborers and service jobs (Ehrenberg and Smith, 1994). The specific breakdown of the occupational fields which comprise each category of community are provided in Table II on the following page. While all of the officers examined in this study are of the same pay grade, this theory can be applied in that occupation effects promotion and promotion leads to higher wages. We would expect, then, that service and support communities would have a lower probability of promotion than combat arms (professionals for which the military was established) and aviation related communities (which in the civilian community have higher wages than other professionals).

Differences in promotion rates could also be a result of the differences in education and training obtained prior to an officer's commission. We would expect that an individual who receives four years of education at a military institution such as the Naval Academy, which also teaches military skills, would be more proficient in their duties and thus be more likely to be promoted. Similarly, we would expect the commissioning source with the least amount of military training to be the least likely to be promoted. These expectations were

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Table II. Occupational Community Variable Composition By Occupational Field (OCCFLD) and Description

VARIABLE	OCCFLD	DESCRIPTION
COMBAT	03XX	Infantry
	08XX	Field Artillery
	18XX	Tank and Assault Amphib
SERVICE	01XX	Personnel and Administration
	34XX	Audit, Finance and Accounting
	40XX	Data Systems
	41XX	Marine Corps Exchange
	43XX	Public Affairs
	44XX	Legal Services
	46XX	Training and Visual Info Support
SUPPORT	02XX	Intelligence
	04XX	Logistics
	13XX	Engineer
	25XX	Communications
	26XX	Signals Intelligence
	30XX	Supply Admin and Operations
	35XX	Motor Transport
AVIATION SUPPORT	59XX	Electronics Maintenance
	60XX	Aircraft Maintenance
	72XX	Anti-Air Warfare
PILOTS	75XX	All pilots and Naval Flight Officers

confirmed by North and Smith (1993) in their study on officer accession characteristics and promotions to captain and major in the Marine Corps. Holding all else constant, they found that Platoon Leaders Class (PLC) and Officer Candidate School (OCS) commissioning

sources had consistently lower promotion probabilities for promotion to both captain and major. In their analysis they also found that Naval Academy (USNA) graduates had the highest probability of promotion, consistent with our assumptions. Additionally, depending on the source of commission, each officer is commissioned as a regular officer or a reserve officer with an active duty period of obligation.[1] Officers who were commissioned through the Naval Academy, the Marine Enlisted Commissioning Education Program (MECEP), and those Reserve Officer Training Corps (ROTC) officers who obtained fully-funded scholarships received regular commissions whereas those who entered through other programs did not.

> The ability to remain on active duty depends on the type of commission. Officers with regular commissions can continue indefinitely as long as they are promoted. Officers with reserve commissions must apply to be augmented into the regular officer corps [at the end of their initial obligation, prior to the promotion to O-4 point] or apply for extensions. Marine augmentation boards have been extremely competitive over the past decade and are much more than mere formalities, as may be the case in other services. (Theilmann, 1990)

In an effort to select the best officers for augmentation, each individual is screened first on the unit level and then by the Commanding General of the major subordinate command (MSC). Each MSC represents a different occupational interest, e.g., a Marine Division has an interest in combat arms, a Marine Air Wing has and interest in aviation, and a Marine Service Support Group has an interest in support occupations. These differences in interests may lead to differences in the number of officers by occupation who ultimately are augmented, stay to the promotion to O-4 point, and who are eventually promoted.

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[1]Recently, a policy was implemented which requires that all officers receive a reserve commission, but for the purposes of this study, the difference must be taken into account.

3. Demographic Characteristics

Several individual demographic characteristics should theoretically effect the performance measures used in this study, with an individual's age being the first. Labor economic theory states that the older an individual is, the less likely that person is to change jobs. This should directly impact the retention behavior of Marine Corps officers. Prior enlisted officers who are older, on average, when commissioned as compared to officers from other commissioning sources should be more likely to remain on active duty. Additionally, age is often used to approximate the amount of work experience an individual has. Age-earnings profiles reflect that those with more work experience have higher earnings. Thus older officer's should be more likely to be promoted.

A second demographic characteristic worth examination is minority status. North and Smith (1993) showed that there were indeed performance differences between population groups since promotion rates were consistently lower for African-Americans than for whites. Several internal studies ensued to evaluate those differences in characteristics and promotion by race. One such study, a Master's thesis prepared by Lieutenant Brian Miller (1995) examined the estimated affects of minority officer retention behavior based on the recent drawdowns in manning levels. He found that African-American Marine Corps officers were more likely at every decision point to separate than white officers. Thus, there are statistical differences in the promotion and retention of different racial/ethnic groups and these differences must be included to examine the independent effects of graduate education on performance. Because the data are limited severely in size, the MINORITY variable combines all minorities into one category. Even still, only 6.2 percent of the officers in the

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1980 cohort are minorities, and the number of observations may be too small to achieve any level of significance.

Gender is another important characteristic which must be considered, but may not be observable due to the small number of observations. Only 4.8 percent of those officers entering the 1980 cohort were women. But,

> ...to the extent that discrimination and other institutional factors restrict the civilian employment opportunities and potential earnings for women... their cost of leaving will be higher. (Mehay and Bowman, 1995)

This implies that women would be more likely to stay, unless of course a choice is made to assume a traditional role of child rearing. Limited research is available on women officers' career decisions in the Marine Corps due to their small numbers in those studies as well, but the models in this research will attempt to capture any significant characteristics leading to their separation decisions or promotion rates, and the effect of graduate education on their performance. This attempt will be accomplished by including the binary variable FEMALE as an explanatory variable in the multivariate models.

Perhaps the most important demographic characteristic of all is an individual's marital status. In every study reviewed for this research, marital status was statistically significant for retention decisions and promotion, no matter how the variable was created. Not only do married men earn more than their non-married counterparts in the civilian sector, suggesting a higher level of productivity, they also tend to stay in the military rather than separate in comparison with their non-married peers. Economically, "the opportunity costs associated with leaving active duty and finding a job are greater for married service members." (Long, 1992) Socially, officers making stay or leave decisions are making life-cycle decisions.

Marriage, as well, is a life-cycle decision, so we can hypothesize that if a service member has already made a decision to marry, then that same individual would be more likely to have made another life-cycle decision. These same life-cycle choices may reflect certain tastes and preferences for the military which could impact individual performance and promotion. Thus, MARRIED will be included in both the retention and promotion models to evaluate the effect of graduate education on on-the-job performance.

The final demographic characteristic which will only be included in the retention equations described in Chapter V is the general unemployment rate for the United States. Previous studies have shown that the civilian work force unemployment rate has an effect on an individual's decision to stay or leave the military. If the unemployment rate is high in a given year, we would expect that an individual would be more likely to stay in the military; whereas, if the unemployment rate is low an individual would be more likely to leave.

B. THE RELEVANT SAMPLES

Two data samples were constructed for analysis in this study. First, a sample was created of all those officers who entered into the Marine Corps in fiscal year 1980. In order to reduce the number of miscellaneous factors influencing promotion to O-4, the following sample restrictions were necessary to ensure homogeneity of the data. First, all warrant officers and limited duty officers were eliminated. Second, any officer who entered with a pay grade higher than second lieutenant was eliminated, since officers who enter with a paygrade higher than O-1 are generally professionals with direct commissions such as Staff Judge Advocates (lawyers). Third, any records with missing variables were eliminated to ensure the binary variables created were not skewed. And finally, those officers with no college degrees

were eliminated, since education is the focus of this study and the fact that not a single officer without a college degree in the sample was promoted to major caused statistical problems with the empirical models. Once these restrictions were imposed, the sample contained 1,087 observations.

The second sample created is simply a subset of the first. By estimating the promotion point to O-4, the variable STAYPROM was created to indicate that an officer remained on active duty long enough to appear before the O-4 promotion board. This is an approximation, since actual promotion board data were not obtained for this study. The promotion model is run using this second sample consisting only of those officers who actually stayed to the promotion point. Of the 1,087 officers who initially entered the 1980 cohort, only 455 stayed to the promotion point, and of the 455 officers who stayed to the promotion point, 314 were promoted to O-4. The approximation technique appears to be valid, since the promotion rate of 69 percent coincides with the average overall promotion rate to major of 67 to 70 percent.

IV. PRELIMINARY DATA ANALYSIS

Before commencing with multivariate analysis, we first examine the data to determine if statistically significant differences exist in the variables selected. Table III, provided on the following page, reports the difference in the values of the independent variable for all officers who entered in 1980. Each cell provides the mean value for a specific variable within its category. For example, of those officers who obtained a postgraduate education since commissioning, their average performance index (AVGPI) is 8.7045, whereas the AVGPI for those officers who did not receive a postgraduate education is 8.3268. This difference between groups within the OBPGRAD category is statistically significant to the one percent level (the T statistic is -11.8603). In isolation, we can conclude that officers who receive a postgraduate education have a higher average performance level than those who have not received a postgraduate education. Other significant differences and conclusions which can be drawn from those who have obtained postgraduate education and those who have not are provided in bullet format below. Officers with postgraduate education are more likely to:

- have a higher average performance level

- receive a better ranking at TBS

- have a commissioning source from the Naval Academy or Officer Candidate School

- have an older average age and have a greater proportion of those who are married.

Table III. Mean Values of Independent Variables and Their Statistical Significance by OBPGRAD and STAYPROM

VARIABLE	Obtained Postgraduate Education			Stayed to O-4 Promotion Point		
	Yes (n=78)	No (n=1009)	T Stat	Yes (n=455)	No (n=632)	T Stat
AVGPI	8.7045	8.3268	-11.8603**	8.6997	8.1071	18.9367**
GCT	124.4893	122.7957	-0.5050	125.3621	121.2261	2.3288*
COMPRK	79.7191	100.0153	3.0507**	86.2220	107.2871	-6.0022**
OBPGRAD	-------------	-------------	-------------	0.1476	0.0211	7.8067**
PLC	0.2105	0.3353	0.5009	0.2953	0.3478	1.9853*
ROTC	0.1158	0.1893	1.7816*	0.2131	0.1634	-2.2359*
ACADEMY	0.2000	0.1059	-2.2291**	0.1421	0.0922	2.7076**
OCS	0.3158	0.2385	-1.6877	0.1944	.2793	-3.5156**
ENLCOM	0.1474	0.1151	-0.8559	0.1308	0.1080	1.2366
COMBAT	0.2737	0.3445	1.4024	0.3364	0.3412	-0.1791
SERVICE	0.1474	0.0834	-1.7092*	0.0897	0.0867	0.1721
SUPPORT	0.2526	0.2244	-0.6093	0.2131	0.2358	-0.9626
AIRSUP	0.0526	0.0617	0.3558	0.0616	0.0606	0.0794
PILOTS	0.2737	0.2861	0.2572	0.2991	0.2753	0.9256
RESERVE	0.6842	0.7014	0.3460	0.6336	0.7470	-4.3355**
AGE	23.8526	23.3495	-2.2765**	23.4374	23.3505	-0.8164
MINORITY	0.0632	0.0592	-0.1516	0.0449	0.0698	1.8708
FEMALE	0.0842	0.0475	-1.2518	0.0449	0.0540	-0.7424
MARRIED	0.7895	0.6839	-2.1469*	0.8729	0.5639	12.5400**

* Significant at the .10 level.
** Significant at the .01 level.

Officers with a service related occupation represent only 8.34 percent of those who have not obtained a postgraduate education, but represent 14.74 percent of those with postgraduate education, indicating that occupational community is important as well. Minority and female

differences were not statistically significant.

Similar statistical differences exist between those who chose to stay to the O-4 promotion point and those who separated. A summary of those statistically significant differences is provided in bullet form below. An officer who chooses to stay to the O-4 promotion point is more likely to:

- have a higher average performance level

- have a higher GCT

- have a better ranking at TBS

- have obtained a postgraduate education (only two percent of those with graduate education separated, whereas fourteen percent of those with graduate education did stay to the promotion point)

- have been commissioned through ROTC, ACADEMY, and ENLCOM sources and less likely to have been commissioned through PLC or OCS sources

- be a regular officer (approximately 75 percent of those who did not stay to the promotion point received reserve commissions, whereas only 63 percent of those who did stay to the promotion point had reserve commissions)

- not be from a minority group (only four percent of those who stayed to the promotion point were minorities)

- be or have been married

These preliminary statistics indicate that the hypotheses formulated in Chapter III have valid foundations. There are significant differences in the individual characteristics between those who obtained postgraduate education and those who stayed to the promotion point, indicating that selection bias could be introduced into multivariate models if a method of controlling for these differences is not employed.

The preliminary analysis is not complete, however, until the second sample of only

those who stayed to the promotion point is examined. Table IV below provides the mean

values and their significance for only those officers staying to the promotion point and

Table IV. Mean Values of Independent Variables and Their Statistical Significance for the Sample of Only Those Staying to the O-4 Promotion Point

VARIABLE	Promoted to O-4 (Stayed to Promotion)		
	Yes (N=314)	No (N=141)	T Stat
AVGPI	8.7643	8.5577	12.2521**
GCT	125.3977	121.9375	1.7852*
COMPRK	80.5116	98.8141	-3.0062**
OBPGRAD	0.1723	0.0941	2.3908**
PLC	0.3205	0.2412	1.9357*
ROTC	0.1973	0.2471	-1.2707
ACADEMY	0.1452	0.1352	0.3052
OCS	0.2027	0.1765	0.7139
ENLCOM	0.1260	0.1412	-0.4743
COMBAT	0.3369	0.3353	0.0385
SERVICE	0.0795	0.1118	-1.1508
SUPPORT	0.2082	0.2235	-0.3980
AIRSUP	0.0603	0.0647	-0.1955
PILOTS	0.3151	0.2647	1.1840
RESERVE	0.6492	0.6000	1.0903
AGE	23.4247	23.4647	0.2117
MINORITY	0.0438	0.0471	-0.1652
FEMALE	0.0329	0.0706	-1.9654*
MARRIED	0.8959	0.8235	2.3472**

* Significant at the .10 level.
** Significant at the .01 level.

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whether promoted to O-4 or not. Not surprisingly, the differences between the majority of the independent variables' mean values have become smaller, and fewer of the independent variables are statistically significant. Of those who stayed to the promotion point, those who were actually promoted had a higher average performance level, had a higher GCT, and were ranked higher at TBS. Only nine percent of those who were not promoted had a postgraduate degree, while 17 percent of those who were promoted did have a postgraduate degree. Neither commissioning source nor occupational community were statistically significant, with the exception that those with a PLC commission did represent a larger proportion of those who were promoted than those were not. Differences also existed by FEMALE and MARRIED.

Analysis of both samples suggests that there are positive effects of having obtained a postgraduate education on staying to the promotion point and being promoted. To further focus the nonparametric analysis toward the question of whether graduate education increases performance, it is also necessary to examine the differences in AVGPI by OBPGRAD. Table V below looks at the mean differences in AVGPI by OBPGRAD for both the sample of all those officers who entered the cohort and those who were promoted to O-4 and are still on active duty as of fiscal year 1994. Not surprisingly, there are large differences in performance

Table V. Mean Average Performance for OBPGRAD by Sample

	Obtained Postgraduate Education		
SAMPLE	Yes	No	T Stat
ENTIRE COHORT	8.7045	8.3268	-11.8603**
STAYPROM	8.7302	8.6944	-1.6007
** Significant at the .01 level			

between those who obtained a postgraduate degree and those who did not in the sample of all those who entered the cohort, but of those who were promoted to O-4 and who remained on active duty, there is no statistical difference in their average performance. To ascertain if the positive effects of graduate education on retention and promotion result in increased performance, it is now necessary to combine the independent variables in multivariate models to isolate the direct effects, if any, of graduate education on performance using the method outlined in the following Chapter.

V. MULTIVARIATE METHOD AND ANALYSIS

Several methods of multivariate analysis are available. Simple regression techniques, or linear probability models (LPMs), estimate a linear function based on the sample data from which estimated coefficients and their statistical significance can be used to predict an outcome. With a binary dependent variable as used in this study, however, LPMs fall short because predicted values of the dependent variables can fall either below zero or above one. The result is a form of sample truncation. A better approach involves fitting the predicted values of the regression estimates in the form of a cumulative distribution function (CDF).

> [T]he CDFs commonly chosen to represent the 0-1 response models are (1)
> the logistic and (2) the normal, the former giving rise to the LOGIT model
> and the latter to the PROBIT (or NORMIT) model. (Gujarati, 1995)

Use of either approach is acceptable, since there are very minute differences in the statistical results (Maddala, 1977). The PROBIT model has been chosen for use in this study.

Since the majority of the literature reviewed in Chapter II focused on the effects of graduate education on promotion, it is first necessary to present a simple promotion model. This simple performance model uses the binary variable PROMOTE as the dependent variable. Officers promoted to O-4 are coded as '1', otherwise the value is zero. The simple promotion model is presented on the following page. As independent variables, COMPRK and OBPGRAD are included as measures of cognitive skill; occupational community, commissioning source, and type of commission are included as affective traits; and AGE, MINORITY, FEMALE, and MARRIED are included as the demographic characteristics.

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PROMOTE = f(COMPRK, OBPGRAD, COMBAT, SERVICE,
SUPPORT, PILOTS, ROTC, ACADEMY, OCS, ENLCOM,
RESERVE, AGE, MINORITY, FEMALE, MARRIED)

This model is run with the data available for this study to initially compare the results to those

of previous studies. The initial results of the simple promotion model are provided in Table

VI below.

Table VI. PROBIT Estimates, Standard Errors, and Statistical Significance for the Simple PROMOTE Model

VARIABLE	ESTIMATED COEFFICIENT	STANDARD ERROR	T STATISTIC
OBPGRAD	0.4761**	0.1959	2.4294
COMPRK	-0.0033**	0.0011	-2.8975
COMBAT	0.0143	0.2837	0.0504
SERVICE	-0.1443	0.3414	-0.4226
SUPPORT	0.0082	0.2893	0.0283
PILOTS	0.0507	0.2958	0.1713
ROTC	-0.3679	0.2762	-1.3319
ACADEMY	-0.2068	0.3366	-0.6145
OCS	-0.0802	0.2065	-0.3885
ENLCOM	-0.2210	0.2805	-0.7880
RESERVE	-0.0134	0.2507	-0.0534
AGE	-0.0424	0.0450	-0.9416
MINORITY	0.0139	0.2916	0.0476
FEMALE	-0.0729	0.3561	-0.2046
MARRIED	0.3179*	0.1909	1.6658
-2LOGL	24.3074**		
* Significant at the .10 level. ** Significant at the .01 level.			

As depicted in Table VI, an individual's class ranking at TBS has a significant effect on the promotion outcome, and OBPGRAD also has a positive, significant effect on promotion. Occupational field, commissioning source, and type of commission have no significant impact on the promotion outcome. Similarly, the only demographic characteristic which is significant is marital status, with those who have ever been married being more likely to be promoted. These results are consistent with previous studies, but it is essential that any potential biases as discussed in Chapter II be addressed to obtain the direct effect of the binary variable OBPGRAD on both promotion and retention.

A. MODELING FOR OMITTED VARIABLE BIAS

One of the potential biases in the simple promotion model is that an individual's ability prior to entering the Marine Corps is never held constant. Those individuals who obtain postgraduate education may have a higher level of ability than their peers, and due to their higher level of performance may be more likely to be promoted. If this is true, then the value of the coefficient for OBPGRAD is overestimated. Another potential bias is the omission of an actual measure of on-the-job performance. Those officers who are selected for graduate education in the Marine Corps are selected based on their promotability. Thus, their average performance may already be higher than their peers, which would account for a higher probability of being promoted. Omission, then, of the AVGPI variable can result in overestimation of the OBPGRAD coefficient. To analytically test these assumptions, it is necessary to run the simple promotion model with GCT, with AVGPI, and with both GCT and AVGPI. If bias does exist, then the coefficients for GCT and AVGPI will be statistically significant and the value of the OBPGRAD coefficient should decrease. If those coefficients

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are not statistically significant, then potential bias does not exist for this sample. Table VII

below presents the results of all variations of the promotion model.

Table VII. PROBIT Estimates and Their Standard Errors for the Promotion to O-4 Multivariate Models

Variable	Model 1 - Simple β (Std Error)	Model 2 - GCT β (Std Error)	Model 3 - AVGPI β (Std Error)	Model 4 - Both β (Std Error)
OBPGRAD	0.4761(0.1959)**	0.4776(0.1963)**	0.3909(0.2327)*	0.3873(0.2331)*
AVGPI	-NA-	-NA-	6.1487(0.6202)**	6.1695(0.6229)**
GCT	-NA-	-0.0017(0.0023)	-NA-	-0.0021(0.0026)
COMPRK	-0.0033(0.0011)**	-0.0034(0.0012)**	-0.0010(0.0013)	-0.0013(0.0014)
COMBAT	0.0143(0.2838)	0.0191(0.2844)	0.2734(0.3393)	0.2837(0.3408)
SERVICE	-0.1443(0.3415)	-0.1385(0.3419)	0.0268(0.3952)	0.0362(0.3962)
SUPPORT	0.0082(0.2893)	0.0221(0.2903)	0.6107(0.3530)	0.6312(0.3550)*
PILOTS	0.0507(0.2958)	0.0705(0.2975)	0.1255(0.3481)	0.1504(0.3504)
ROTC	-0.3679(0.2762)	-0.3624(0.2765)	-0.3568(0.3083)	-0.3510(0.3086)
ACADEMY	-0.2068(0.3366)	-0.1838(0.3383)	0.0390(0.3838)	0.0706(0.3862)
OCS	-0.0802(0.2065)	-0.0726(0.2069)	0.1426(0.2468)	0.1561(0.2479)
ENLCOM	-0.2210(0.2805)	-0.2061(0.2818)	-0.1487(0.3353)	-0.1276(0.3378)
RESERVE	-0.0134(0.2507)	-0.0191(0.2511)	0.0306(0.2851)	0.0195(0.2858)
AGE	-0.0424(0.0450)	-0.0412(0.0451)	-0.0772(0.0525)	-0.0772(0.0526)
MINORITY	0.0139(0.2916)	0.0124(0.2916)	0.3808(0.3437)	0.3840(0.3442)
FEMALE	-0.0729(0.3561)	-0.0929(0.3568)	0.2027(0.4389)	0.1806(0.4389)
MARRIED	0.3179(0.1909)*	0.3171(0.1910)*	0.0209(0.2349)	0.0184(0.2353)
-2LOGL	24.3074**	24.8294**	170.9428**	171.5987**
* Significant at the .10 level ** Significant at the .01 level				

Three phenomena are apparent in assessing the impact of ability and actual performance when

included in the simple multivariate model promotion model. First, when GCT and AVGPI

are included in model, the standard errors of the coefficients of all other variables increase in size, reducing their significance. Second, the coefficient of GCT is not significant in models 2 or 4, while in Models 3 and 4 AVGPI is the single most significant variable in the multivariate model. Finally, the coefficient of the OBPGRAD decreases from 0.48 to 0.39. Thus, omitting GCT and AVGPI appears to cause the coefficient of OBPGRAD to be overestimated.

There are several ways of assessing the goodness of fit of multivariate models. One way is to examine the chi-square value of the log-likelihood statistic (-2LOGL). This method tests the null hypothesis that all variables included as explanatory variables in a model are simultaneously equal to zero. This test is usually considered to be a poor assessment of the goodness of fit because multivariate models rarely fail to meet the required confidence level. We can, however, compare the level of significance depicted by the -2LOGL value to assess if one model predicts the outcome variable better than another model with other explanatory variables. Based on this approach to determining the goodness of fit of the models, the largest increase in the -2LOGL value occurs when AVGPI is included in Model 3.

A second method of assessing the goodness of fit of the models is to inspect the interrelationships between the variables included in the model. This is accomplished through a correlation analysis. If two or more variables are highly correlated with each other, then the direct effect on the dependent variable can be obscured. Appendix B provides the correlation matrices for each multivariate model presented in this Chapter. This process of assessing goodness of fit is also generally a weak measure, since at least some correlation between variables will always be present. The ultimate purpose of assessing goodness of fit is to

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determine if the "true" selection model has been specified with the variables available. By examining the promotion model correlation matrix, AVGPI appears to be a reliable variable when compared to the others. The largest correlation present is between AVGPI and COMPRK of -0.23, and the effects of this relationship can be observed by the lack of statistical significance of the COMPRK coefficient when AVGPI is included. The correlation between AVGPI and OBPGRAD is not statistically significant. Using correlation analysis as an approach to measuring goodness of fit also results in the conclusion that the models which include AVGPI are best. Actual on-the-job performance is important in the promotion outcome, then, while ability as measured by GCT is not.

B.   MODELING FOR SAMPLE SELECTION BIAS

In the preliminary data analysis of Chapter IV, differences between those who obtained graduate education and those who did not were significant in both the overall sample and the sample of only those who stayed to the promotion to O-4 point. Then in examining potential omitted variable bias, average performance is found to be a significant factor in the promotion outcome. But, theoretically average performance should also explain who chooses to attend graduate education and who decides to stay to the O-4 promotion point. Both of these potential sample selection biases may affect the promotion outcome and require examination. To do so, promotion must be modeled as an ordinary least squares equation, and a selection term (Mills' ratio) for each type of bias must be included. This procedure is not exactly precise, but it will provide an indication of whether a potential bias may be present.

The first type of potential selection bias deals with the OBPGRAD choice. Marine

Corps officers who volunteer are screened for eligibility by Headquarters Marine Corps prior to assignment to fully funded graduate education programs. Two types of officers could potentially be volunteers: those who desire a graduate education to enhance their employment opportunities in the civilian sector once their obligated service is complete, or those who desire further education to enhance their performance in their respective occupations or the Marine Corps overall. In the screening process at Headquarters Marine Corps, officers are selected to graduate education based on their ability, performance, and promotability. The goal is for all officers sent to graduate programs to be competitive for promotion to the next higher grade to ensure that the officers will be able to fulfill their incurred obligated service. Thus, one potential sample selection bias could be that the coefficient of OBPGRAD is overestimated in the simple promotion model due to the fact that the group of officers selected for OBPGRAD are more promotable by virtue of the selection process.

The second potential sample selection bias could involve differences in characteristics between those who stay to the promotion point and those who do not. Table III in Chapter IV provides clear evidence that this may be the case. Only two percent of those who did not stay to the promotion point obtained a postgraduate education, while 14 percent of those who did stay to the promotion point had graduate education. Their AVGPI, GCT, COMPRK, commissioning source, type of commission, and marital status also have statistically significant differences. Two principal possibilities exist for those who separate prior to the promotion point. First, an officer who is an outstanding performer may separate since better opportunities exist in the civilian sector. Second, officers who are aware that they have a

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lower performance level than their peers may choose to separate prior to the promotion point, anticipating non-selection. Those with graduate education may only stay to the promotion point as a result of the incurred obligated service. Each of these biases require that the same individual's choices and characteristics be measured and analyzed over time.

To measure the effect of graduate education on performance while controlling for these two potential sample selection biases, separate selection models must be specified and a sequence of models is necessary. This sequencing of models is done in a two stage procedure commonly called the Heckman Procedure (Heckman, 1979), which only the PROBIT software is capable of accomplishing. In the first stage, a PROBIT model is run with the suspected source of bias as the dependent variable. At least one of the independent variables included in that first stage specification must be unrelated to the dependent variable of the second stage ordinary least squares (OLS) model. When the first stage is run, in addition to providing the normal estimated coefficients and their statistical significance, a correction factor is generated that encompasses those unobserved factors left in the error term. This correction factor is an inverse Mills' ratio. A second stage OLS model is then run with the promotion to O-4 outcome as the dependent variable and includes as independent variables the inverse Mills' ratio, the suspected source of bias variable, and the other constructed variables which theoretically effect the dependent variable. The use of a PROBIT model is not possible in the second stage due to excessive correlation of the error term resulting from using the same functional form in both stages. When the range of the dependent variable is restricted between 0 and 1, the curves produced in both stages are almost identical and the estimates of the coefficients are biased. To avoid this problem, OLS

allows the binary dependent variable to be continuous, expanding beyond 1 and below 0.

1. The OBPGRAD Selection Model and Results

To answer the questions under analysis in this study, a model must first be specified which predicts whether an individual participates in graduate education or not. By doing so, the inverse Mills' ratio can be included in the promotion performance model to control for potential biases from sample selection. The graduate education selection model is:

$$\text{OBPGRAD} = f(\text{AVGPI, GCT, COMPRK, ROTC, ACADEMY, OCS,}$$
$$\text{ENLCOM, MINORITY, FEMALE, MARRIED})$$

This model assumes that four selection factors are involved with choosing postgraduate education. One factor is that to be selected for graduate education an officer must be promotable, and AVGPI is the principal component for determining whether an officer is promotable. The second factor is that an individual must meet the eligibility requirements for attendance at a graduate level institution. GCT, COMPRK, and source of commission variables are used to proxy an individual officer's ability. The third factor is that to apply for graduate education while in the military requires that additional obligated service be incurred. Finally, the graduate education choice is a personal one, and individuals from different backgrounds (MINORITY, FEMALE) or who have made other life-cycle choices such as marriage may have different effects on the graduate education choice. To continue to test for omitted variable bias, the OBPGRAD selection model will be run three times.

Table VIII on the following page presents the results of the multivariate PROBIT model with OBPGRAD as the dependent variable. During the execution of the program a selection bias correction term (MILLS1) is produced for use in the second stage OLS

Table VIII. PROBIT Estimates and their Standard Errors for the OBPGRAD Selection Model

Variable	Model 1 - Simple β (Std Error)	Model 2 - GCT β (Std Error)	Model 3 - AVGPI β (Std Error)	Model 4 - Both β (Std Error)
AVGPI	-NA-	-NA-	1.5259(0.2858)**	1.5257(0.2858)**
GCT	-NA-	-0.0005(0.0022)	-NA-	-0.0001(0.0024)
COMPRK	-0.0038(0.0011)**	-0.0038(0.0011)**	-0.0017(0.0012)	-0.0017(0.0012)
ROTC	0.3217(0.2891)	0.3224(0.2890)	0.2494(0.3026)	-0.2498(0.3027)
ACADEMY	1.0369(0.3403)**	1.0450(0.3426)**	0.9394(0.3531)**	0.9413(0.3557)**
OCS	0.2598 (0.1764)	0.2614(0.1766)	0.2833(0.1890)	0.2837(0.1893)
ENLCOM	0.1146(0.2516)	0.1199(0.2528)	0.1057(0.2741)	0.1070(0.2754)
MINORITY	0.2159(0.2452)	0.2130(0.2456)	0.3149(0.2684)	0.3143(0.2687)
FEMALE	0.4819(0.2575)**	0.4823(0.2575)**	0.5303(0.2730)*	0.5302(0.2730)*
MARRIED	0.3332(01491)**	0.3336(0.1491)**	0.0992(0.1641)	0.0992(0.1641)
-2LOGL	44.2431**	44.2866**	88.8628**	88.8648**

* Significant at the .10 level
** Significant at the .01 level

promotion model. Not surprisingly, an officer's average performance, commission source from the Naval Academy, and gender are statistically significant in all four models of the choice to obtain postgraduate education. An officer's composite ranking at TBS and marital status appear to be positive and significant in models 1 and 2, but when AVGPI is included in models 3 and 4 their coefficients deflate significantly. GCT had no statistical significance on the choice to obtain postgraduate education in any of the models in which it was included. These results indicate that, for the 1980 cohort, better performers are more likely to choose or be selected to obtain graduate education, an officer's commissioning source can contribute to the selection, and female officers are more likely than men to obtain graduate education.

The chi-square -2LOGL value of 88.86 in models 3 and 4 indicates goodness-of-fit of either model. Also, upon review of the correlation matrix provided, the only significant correlation between the independent variables exists between AVGPI, COMPRK, and MARRIED. Since the standard errors of the COMPRK and MARRIED variables did not inflate, no evidence is present which would cause multicollinearity problems in the reliability of the coefficient estimates. The selection equation for the potential OBPGRAD bias is complete, and it is now necessary to continue with the examination of retention and promotion.

2. The STAYPROM Selection Model and Results

The purpose of the retention model is twofold. First, the direct effect of graduate education on retention as a measure of performance can be obtained by including OBPGRAD as an independent variable in the retention equation. Second, a second selection bias correction term, different from the first which was obtained for the potential OBPGRAD selection bias, can be obtained to control for the potential bias in the promotion outcome from an individual's retention decision. The retention model is:

STAYPROM = f(AVGPI, COMPRK, OBPGRAD, COMBAT, SERVICE, SUPPORT PILOTS, ROTC, ACADEMY, OCS, ENLCOM, RESERVE, AGE, MINORITY, FEMALE, MARRIED, UNEMP)

As evidenced in the OBPGRAD and simple promotion models, AVGPI has been the most significant explanatory variable, so an effort must be made to ascertain whether the effect of AVGPI is increasing the variance of the other explanatory variables such that their significance is diminished. To distinguish the effect of including AVGPI, the STAYPROM models will also be run with and without the AVGPI variable. The assumptions for the causal

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variables effecting the retention decision are very similar to those in the graduate education selection model, with the exception that UNEMP and AGE are included as independent variables since they are theoretical contributors to the retention decision but not to the graduate education decision, and GCT is excluded. Table IX provided below presents the

Table IX. PROBIT Estimates and Their Standard Errors for the STAYPROM Selection Models With and Without Average Performance as an Explanatory Variable

VARIABLE	Model 1		Model 2	
	Estimated Coefficient	Standard Error	Estimated Coefficient	Standard Error
OBPGRAD	1.0656**	0.2641	0.8632**	0.2687
AVGPI	-NA-	-NA-	2.0479**	0.2558
COMPRK	0.0002*	0.0009	0.0024*	0.0010
COMBAT	0.1744	0.2427	0.1977	0.2630
SERVICE	0.2388	0.2926	0.2605	0.3189
SUPPORT	0.0719	0.2492	0.1594	0.2695
PILOTS	-0.1477	0.2427	-0.1432	0.2632
ROTC	0.0983	0.2668	0.1365	0.2897
ACADEMY	0.0499	0.3129	0.0836	0.3361
OCS	-0.0814	0.1663	-0.0826	0.1787
ENLCOM	0.2326	0.2445	0.4037	0.2768
RESERVE	-0.1889	0.2503	-0.0693	0.2708
AGE	0.4321	0.0407	0.0491	0.0444
MINORITY	-0.0254	0.2279	-0.0021	0.2557
FEMALE	0.0176	0.2709	-0.0604	0.2849
MARRIED	0.7567**	0.1289	0.6395**	0.1384
UNEMP	-40.9408**	2.8581	-32.8769**	2.9699
-2LOGL	756.8156**		851.2565**	
* Significant at the .10 level.				
** Significant at the .01 level.				

results of the PROBIT STAYPROM selection models. During the execution of the program a selection bias correction term (MILLS2) is produced for use in the second stage OLS promotion model. As expected, OBPGRAD and MARRIED are positive and significant in both models, while UNEMP and COMPRK are negative and significant determinants in staying to the O-4 promotion point in both models as well. AVGPI, when included in model 2, is once again a statistically significant factor. The higher an individual's performance, the more likely the individual will stay to the O-4 promotion point. Inclusion of the AVGPI variable does cause inflation of the standard errors and reduces the coefficient values of the other independent variables in the model, but does not severely effect their statistical significance. It appears that in the retention decision, the unemployment rate is the single most important factor. Neither occupational community nor commissioning source are statistically significant on the retention decision in either model; additionally, AGE, MINORITY status, and being FEMALE are also not significant. Because the -2LOGL values are greater in model 1 than 2, the model including AVGPI better predicts obtaining a postgraduate education and staying to the O-4 promotion point and will be used to generate the MILLS2 error correction term.

3.   The OLS Second Stage PROMOTE Model and Results

This final performance model still uses the binary variable PROMOTE as the dependent variable, although the OLS method will allow its values to exceed the range between 0 and 1. This model will be run four separate times. Since the OLS method will provide substantially different estimates of the coefficients than the PROBIT method, the simple promotion model will be run once without using AVGPI and once with AVGPI

included. The OLS PROMOTE model will then be run once with the addition of the selection bias correction term from the graduate education selection model (MILLS1), and once with the addition of the selection bias correction term from the retention selection model (MILLS2). The fully specified promotion model, excluding the selection bias correction terms, is as depicted on page 38 of this Chapter.

In order to assess the direct effect of obtaining a postgraduate education on promotion, comparison of the four different models is necessary. Table X provided on the following page is presented to easily compare the results of all four models. Chapter III outlines the theoretical rationale for including the variables listed in the multivariate equation. If either MILLS1 or MILLS2 are statistically significant, then selection bias can be considered to be present.

The best way to discuss the results in Table X is to compare the OLS results with the simple PROBIT promotion model results presented in Table VII. In the first model of Table X and the second model of Table VII, which do not include AVGPI, both COMPRK and OBPGRAD are statistically significant. MARRIED is significant in the PROBIT model, but is not significant in the OLS model. Then, when AVGPI is included in those models COMPRK loses its significance, while OBPGRAD still remains positive and significant on promotion. MARRIED is not significant in either the PROBIT or OLS promotion model when AVGPI is included. In the PROBIT model, SUPPORT has a significant positive effect on promotion, but is not significant in the OLS model. Inversely, ROTC is not significant in the PROBIT model, but is negative and significant in the OLS model. Overall, the significant variables and the direction of their effect are quite consistent.

Table X. OLS Estimates and Their Standard Errors for the Second Stage Promotion to O-4 Multivariate Models

Variable	Model 1 β (Std Error)	Model 2 β (Std Error)	Model 3 β (Std Error)	Model 4 β (Std Error)
OBPGRAD	0.1458(0.0618)**	0.0919(0.0523)*	-0.4483(0.4513)	-0.0818(0.0318)**
AVGPI	-NA-	1.5341(0.1152)**	1.6853(0.1703)**	-0.2357(0.0929)**
GCT	-0.0006(0.0008)	-0.0004(0.0007)	-0.0004(0.0007)	-0.0005(0.0004)
COMPRK	-0.0012(0.0004)**	-0.0002(0.0003)	-0.0003(0.0004)	-0.0006(0.0002)**
COMBAT	0.0067(0.0983)	0.0493(0.0831)	0.0528(0.0831)	0.0166(0.0495)
SERVICE	-0.0514(0.1192)	-0.0121(0.1007)	-0.0096(0.1007)	-0.0567(0.0560)
SUPPORT	0.0096(0.1006)	0.1216(0.0854)	0.1262(0.0854)	0.0111(0.0510)
PILOTS	0.0204(0.1024)	0.0248(0.0865)	0.0282(0.0865)	0.0986(0.0516)*
ROTC	-0.1214(0.0959)	-0.1399(0.0810)*	-0.1589(0.0825)*	-0.1745(0.0483)**
ACADEMY	-0.0569(0.1170)	-0.0591(0.0988)	-0.0198(0.1040)	-0.1701(0.0589)**
OCS	-0.0259(0.0691)	0.0308(0.0585)	0.0775(0.0702)	0.0358(0.0349)*
ENLCOM	-0.0698(0.0957)	-0.0241(0.0809)	-0.0007(0.0831)	-0.0978(0.0482)*
RESERVE	-0.0041(0.0877)	-0.0478(0.0741)	-0.0577(0.0745)	-0.0794(0.0441)**
AGE	-0.0135(0.0154)	-0.0198(0.0130)	-0.0203(0.0130)	-0.0236(0.0077)
MINORITY	-0.0040(0.1003)	0.0509(0.0848)	0.0925(0.0915)	0.0566(0.0505)
FEMALE	-0.0365(0.1275)	0.0396(0.1078)	0.1200(0.1268)	0.0224(0.0642)
MARRIED	0.1078(0.0680)	0.0129(0.0578)	0.0196(0.0581)	-0.1675(0.0350)**
MILLS1	---------------------	--------------------	0.2806(0.2328)	----------------------
MILLS2	---------------------	--------------------	-----------------------	-0.8233(0.0292)**
F VALUE	1.529*	12.444**	11.845**	77.426**

* Significant at the .10 level
** Significant at the .01 level

When controlling for potential selection bias due to the graduate education decision

in model 3 of Table X, quite different results emerge. AVGPI is still positive and significant,

but the coefficient of OBPGRAD changes direction and becomes insignificant. The lack of

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significance of the MILLS1 coefficient, however, may indicate that who chooses OBPGRAD is not an important factor in the promotion outcome. The coefficient of OBPGRAD is not significant, and the standard error is quite large. The standard error increases from 0.05 in model 2 to 0.45 in model 3. MILLS1 and OBPGRAD are significantly correlated with each other such that MILLS1 may explain more about the graduate education decision than OBPGRAD itself. This suggests that the OBPGRAD selection model used in the first stage of this analysis is poorly specified. In order to further investigate the potential bias in the coefficient of OBPGRAD due to the fact that individuals are not randomly selected to attend graduate education, it is important to better specify the graduate education selection equation. Future research should focus on this problem.

When controlling for potential selection bias due to the stay or leave decision in model 4 of Table X, quite different results emerge as well. The retention selection bias correction term MILLS2 is significant in model 4 of Table X, so examining the OBPGRAD coefficient, its direction, and significance is key to determining the direct effects of OBPGRAD on promotion. When MILLS2 is included, OBPGRAD has a significant negative effect on the probability of promotion to O-4. In this model, as opposed to the model with MILLS1, there is no significant problem with the inflation of the standard errors of the coefficients. The only significant correlation exists between the AVGPI and MILLS2 variable, but the correlation coefficient of 0.48 is much smaller than the 0.98 correlation coefficient observed between OBPGRAD and MILLS1 in model 3. The AVGPI variable changes sign, but remains significant. Superficially, the coefficient of AVGPI looks suspect, but theoretically, if more officers stay to the promotion point, the mean average performance of those promoted would

slightly decrease towards the mean of the entire cohort. Similarly, if more officers stay to the promotion point and do not have graduate education, then the probability that an individual with graduate education will be promoted should decline. Additional results, when controlling for potential retention selection bias, i.e., remembering that graduate education carries with it an additional obligated service commitment, are summarized below:

- COMPRK is statistically significant even when AVGPI is included

- PILOTS are more likely to be promoted than other occupations

- ROTC, ACADEMY, and ENLCOM are less likely to be promoted than other commissioning sources

- RESERVE and MARRIED are less likely to be promoted than those with regular commission types and officers who have never been married

One of the confounding factors involved in the STAYPROM selection model is that officers who obtain a postgraduate degree incur an additional obligated service commitment of up to four years. Because of this additional commitment, officers with graduate education should be more likely to stay to the promotion point. Additionally, because more officers with graduate education stay to the promotion point, they may or may not be more likely to be promoted. Table XI on the following page presents the retention rates to the promotion point, the promotion rates to O-4, and the retention rates to year 14 (the last year of the cohort obtained) for the samples of those with and without graduate education. In Table XI, the significantly higher retention rates to the O-4 point for those with graduate education compared to the lower retention rates after the O-4 point suggest that there may be potential

Table XI. Retention and Promotion Rates for Three Samples as Categorized by Graduate Education Subgroup

	Graduate Education	
Rates by Sample	**Yes (N=95)**	**No (N=1294)**
Retention Rate to O-4 Point	83.16%	38.03%
Promotion Rate at O-4 Point	78.48%	65.13%
Retention Rate after O-4 Point	90.32%	93.94%

retention selection bias which could result in an overestimate of the OBPGRAD coefficient in the promotion model.

Making definitive conclusions from these models, however, must be cautious. First of all, using OLS in the second stage expands the binary PROMOTE variable into a continuous variable, which can result in a form of truncation bias. Values of the coefficients can exceed one and be below zero, when in reality this cannot be the case. There are several more sophisticated techniques to control for the correlation between the error terms of the first and second stages of the sequential models which would allow for examination of the specific marginal effects of each independent variable. The only conclusions which may be drawn from the techniques used in this research are general in nature. Only the direction of the potential bias can be addressed. Additionally, it is difficult to determine exactly what the coefficient of the MILLS2 term tells us other than that it accounts for the unexplained variance in the retention model. Since MILLS2 is significant, though, there is cause to believe that the effects of retention are significant and must be addressed. Table XII on the following page provides a recapitulation of the results of this Chapter specifically with regard to the coefficient of the OBPGRAD variable. Table XII clearly shows general trends, even though

the values of the coefficients are quite different. In all models, the value of the coefficient of

OBPGRAD decreases when average performance is included. This trend is also consistent

Table XII. Comparison of the OBPGRAD Coefficient by Type of Performance Model and Average Performance Variable

Type of Performance Model	Average Performance	
	Not Included	Included
PROBIT Simple PROMOTE Model	0.48**	0.39**
PROBIT STAYPROM Model	1.07**	0.86**
OLS Simple PROMOTE Model	0.15**	0.09*
OLS PROMOTE with MILLS1	2.84**	-0.45
OLS PROMOTE with MILLS2	-0.07**	-0.08**
* Significant at the .10 level ** Significant at the .01 level		

in the second stage OLS promotion models. The consistency provides sufficient reason to

infer that in estimating the effect of graduate education on promotion, it is necessary to be

concerned with potential biases due to omitted variables (such as cognitive ability or actual

on-the-job performance), and issues relating to selection to graduate education and retention.

Overall, it is not surprising that in the PROMOTE models intelligence, commissioning

source, occupational community, and other demographic characteristics are not consistently

significant in the promotion outcome. We would expect that the promotion process selects

officers for promotion based on actual performance, given that the individual has stayed to

the promotion point, and not based on the categorization of the individual officer. Other

studies as discussed in Chapter II found that demographic characteristics did affect retention

and promotion outcomes; they did not, however, take into account that actual on-the-job

performance is the principal factor in determining performance outcomes. If performance data were available, and correction techniques for potential omitted variable and selection biases were employed, perhaps comparable results with this study would be obtained. Hopefully, all studies in the future will include an actual measure of performance.

VI. CONCLUSIONS AND RECOMMENDATIONS

A.   CONCLUSIONS

The results of this research show the complex interrelationships between the performance measures of promotion and retention, especially when trying to focus on the effects of a specific independent variable, in this case the effect of OBPGRAD. The results do show that there is a common denominator throughout. This common variable is an individual's actual on-the-job performance as measured in this study by AVGPI. Examining nonparametric statistics, officers who have obtained a postgraduate degree since commission do have a higher average performance index than those who have not obtained a postgraduate degree.

By first specifying and running a simple PROBIT promotion model, subsequent tests were performed to determine if potential omitted variable and sample selection biases were present. AVGPI and GCT were first included, and the effect of obtaining a postgraduate degree was significantly reduced in the promotion to major (PROMOTE) model. AVGPI was found to be the most significant variable in predicting promotion, and its omission was shown to overestimate the effect of OBPGRAD on the performance outcome. Two PROBIT models were then specified to determine the other performance measures of obtaining a postgraduate education (OBPGRAD) and staying to the promotion point (STAYPROM). These models also were run with and without AVGPI as an explanatory variable, and the effect of OBPGRAD was again reduced. Knowing that each performance measure was linked to AVGPI and other interdependent variables, further analysis was conducted through the use

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of a final series of OLS promotion models. The first OLS was a simple model identical to the PROBIT specification. The second included AVGPI, and consistent results confirmed that not including AVGPI leads to an omitted variable bias in the estimated effect of OBPGRAD on promotion. The third model was run with a correction term for the potential OBPGRAD selection bias. While the correction term was not significant, the coefficient of OBPGRAD did decrease and became insignificant in the promotion model. Finally, a last model was run with a correction term for the potential STAYPROM selection bias. This time, the correction term was significant and the OBPGRAD coefficient did decrease such that it changed signs while it still remained significant. The consistency of the direction of these results suggests that failure to correct for retention and selection issues biases the effect of OBPGRAD upward.

The results of the simple promotion and retention models are consistent with several prior studies on USN and USMC officers, but the inclusion of the selection bias correction terms results in contradictory findings. One possible explanation is that the data used for the majority of those studies was cross-sectional and did not accurately predict the characteristics associated with the retention decision. Several of those studies which did use longitudinal, cohort data did not focus their research on the direct effects of postgraduate education; rather, the postgraduate variable was simply included as an explanatory variable in either promotion or retention models. Those studies which did examine postgraduate education exclusively often did not include an actual on-the-job performance measure and did not employ the statistical method applied in this study. As we have seen, postgraduate education did have a positive, significant effect on promotion and retention when no effort to control

for potential selection bias was taken. Another plausible explanation is that quite possibly, differences between services may exist between the Navy and Marine Corps, since selection procedures for graduate education are distinctly different. For the Navy, attending the Naval Postgraduate School is an option for most junior officers and is strongly encouraged, while for the Marine Corps, attendance is based on a voluntary, more selective basis for a substantially smaller number of individuals.

Other variables, which do have a theoretical economic basis for possibly effecting the outcome of performance measures were found not to be statistically significant in this study. The military is a hierarchal organization with no lateral entry, and promotion is principally linked to the time in service an officer has served. Thus, many economic principles may not apply to studies conducted on the military, especially the United States Marine Corps. To best determine the impact of a program such as graduate education, this study confirms that it is necessary to ascertain first what type of individual chooses graduate education, to assess the impact of those same characteristics on retention decisions, and then to analyze the performance outcome of promotion. To conduct a study on measures of on-the-job performance in any other sequence could result in substantially biased conclusions.

The purpose of this study was not to determine the specific marginal benefits of graduate education, but rather to determine the direction of the effect when the interaction of retention decisions was taken into account in the analysis of the promotion outcome. Some advocates may argue that controlling for potential selection bias due to the retention decision is not necessary to analyze future promotion points, after all, retention is primarily an individual decision, and the pyramid grade structure of the Marine Corps is such that it is

desirable to have officers separate. Yet, these skeptics may fail to understand the manpower process as it applies to manpower and personnel programs and policies. The results of this study demonstrate that some programs and policies are working rather well. The fact that an officer's GCT and occupational community are not consistently significant in the STAYPROM or PROMOTE models indicates that the 'quality spread' program at TBS may be working. Intelligent and motivated individuals are being assigned to occupations equally which results in the similarity in performance outcomes. Additionally, the fact that individual demographic characteristics are not significant suggests that promotion boards are doing a superb job at selecting individual's based on their actual on-the-job performance rather than age or sex. None of these conclusions could be made if the retention selection bias had not been included in the analysis.

The disturbing result of this study is that graduate education programs in general appear to be resulting in a lower predicted probability of promotion even though those with graduate education actually perform better. If the desire is to increase performance through education, then steps must be taken to improve retention and promotion through changes to existing programs and policies. Based on the current graduate education programs and the findings of this study, one could hypothesize that the magnitude of the negative impact on retention and promotion is even greater for later years of service (beyond twelve years) and higher pay grades (lieutenant colonel and above).

These results apply solely to the cohort of officers who entered the Marine Corps in 1980. Prior studies discussed in Chapter II have shown that there are differences in characteristics by cohort, so generalizing these results to the entire population of officers in

the Marine Corps would be inappropriate. In recent years the military has changed its focus on the importance of graduate education and the results for more recent cohorts may be completely different.

The next logical step in future research would be to attempt more difficult, sophisticated techniques to determine precisely what the marginal effects of the independent variables may be. Future research should invesitigate the effect of graduate education using bivariate PROBIT or instrumental variable techniques.

B.   LIMITATIONS

The results of this study show significant patterns for the cohort obtained, however, the size of the data sample and the contents severely limited the full analysis of explanatory variables which have a theoretical basis for inclusion in the multivariate models. Unfortunately, previous studies have shown that there are significant differences between cohorts, and this study could not address those issues, since comprehensive data has not logically been stored in longitudinal structure prior to 1986. Also, several theoretical variables could not be included in the models due to the lack of information available in the data sample obtained. The fitness report file did not contain reporting occasion information, nor did it contain an officer's ranking amongst his or her peers, important information which has been used for several years. Without reporting occasion information, it was not possible to construct a performance variable to document the before and after treatment effects. For example, it would be beneficial to identify the year an officer achieves a graduate degree, match that year with the fitness report file, and construct the level of performance before receiving a degree and after receiving one.

As witnessed by the lack of significance of the MILLS1 selection bias correction term, more information is necessary to specify a more predictive model to determine who actually chooses OBPGRAD. Also, information such as college grade point average, type of major, and information about the graduate education institution would be helpful. This research only examined graduate education in general, but there are three types of which each could have different effects on performance outcomes. Officers who are selected to the fully funded special education program, for example, may be a substantially different group of individuals than those who attain a graduate degree using tuition assistance and attending classes in the evening on their own time. A more predictive OBPGRAD selection equation is necessary to determine the effects of potential selection bias.

Additionally, other factors must be examined which were not available for this study. The amount of time an officer spends in his or her MOS should reveal possible changes for graduate education programs. Currently, officers who receive a fully funded graduate degree are not in their primary MOS for about five years (two years obtaining the education, and three years serving in billet requiring the graduate degree). These billets are not usually in the operational community, so the amount of time officers have served in the FMF should also be examined. Finally, the point in time an officer acquires postgraduate education is important. As discussed in Chapter I, officers in the Marine Corps who desire to make their service a career must follow a general career path to be successful. Attending graduate education and serving in a pay-back tour remove them from that career path. Thus, the year graduate education is obtained and the type of degree, whether similar to one's MOS or not, are important. Obviously, an officer with a combat arms MOS who obtains an engineering

degree and serves in an engineering billet, while his peers in the FMF are serving as company commanders, will lose some proficiency in his primary occupation. An officer with a support MOS such as Disbursing Officer who receives a degree in financial management, on the other hand, should be able to perform as well or better than his peers without graduate education.

C.   RECOMMENDATIONS

Two principal recommendations result from the findings and limitations of this study. One is that future studies on the effect of graduate education be conducted which include:

- Differentiation between the type of graduate education received compared to the officer's occupational specialty to determine if the effects are general or firm specific in nature,

- More than one cohort to assess the differences in performance measures and program effects over time,

- A focus on the time an officer spends in his or her MOS as well as how much time in the operating forces the individual has prior to and after receiving graduate education and the subsequent effect on promotion to higher grades, and

- Analysis of the effects of graduate education on promotion to O-5 and above, while including a correction term for potential selection bias due to the retention decision.

The second recommendation is that data sources be improved to consolidate service related information. During the data collection for this thesis, it was discovered that every variable necessary for analysis was originated and stored by a different organizational sponsor. Promotion information is maintained by the promotion branch, performance information is maintained by the performance branch, and so on. Additionally, files are separated between those who are on active duty and those who have separated, and those who have separated

are generally stored by the year separated. Often times the variables stored on those who are on active duty and those who have separated are very different. To conduct proper analyses in the future, it is necessary that separation files and active duty files be combined, and information from different organizational sponsors should be consolidated into a master file as well.

APPENDIX A. DATASET VARIABLES AND THEIR DEFINITIONS

#	Variable	Type	Len	Pos	Label
25	AAE80-94	Num	2	55	AGE AT ENTRY
835	AAE_L	Num	2	2035	
928	ACADRK	Num	8	2580	ACADEMIC CLASS STANDING AT TBS
932	ACADTHRD	Num	8	2606	ACADEMIC TBS PLACEMENT BY THIRD
53	AFRS80-94	Char	2	128	AIR FORCE RECORD STATUS
26	AGE80-94	Num	2	57	AGE AT SEPARATION/AS-OF-DATE
836	AGE_L	Num	2	2037	
901	AIRSUP	Num	8	2412	60, 66, 72 AND 73
52	ALTC80-94	Char	2	126	ARMY LATEST TRANSACTION CODE
955	AVGB15	Num	8	2790	AVERAGE BLOCK MARKINGS FOR FITREPS
934	AVGB13A	Num	8	2622	
935	AVGB13B	Num	8	2630	
936	AVGB13C	Num	8	2638	
937	AVGB13D	Num	8	2646	
938	AVGB13E	Num	8	2654	
939	AVGB13F	Num	8	2662	
940	AVGB13G	Num	8	2670	
941	AVGB14A	Num	8	2678	
942	AVGB14B	Num	8	2686	
943	AVGB14C	Num	8	2694	
944	AVGB14D	Num	8	2702	
945	AVGB14E	Num	8	2710	
946	AVGB14F	Num	8	2718	
947	AVGB14G	Num	8	2726	
948	AVGB14H	Num	8	2734	
949	AVGB14I	Num	8	2742	
950	AVGB14J	Num	8	2750	
951	AVGB14K	Num	8	2758	
952	AVGB14L	Num	8	2766	
953	AVGB14M	Num	8	2774	
954	AVGB14N	Num	8	2782	
933	AVGPI	Num	8	2614	
918	AWDS	Char	16	2532	NUMBER AND TYPE OF PERSONAL AWARDS
32	BASDDY80-94	Num	2	69	BASIC ACTIVE SERVICE DATE - DAY
842	BASDDY_L	Num	2	2049	
31	BASDMO80-94	Num	2	67	BASIC ACTIVE SERVICE DATE - MONTH
841	BASDMO_L	Num	2	2047	
30	BASDYR80-94	Num	2	65	BASIC ACTIVE SERVICE DATE - YEAR
840	BASDYR_L	Num	2	2045	
881	CC80-94	Num	8	2252	COMPETITIVE CATEGORY
908	COLGRAD	Num	8	2468	ENTERED AND STILL IS COLLEGE GRADUATE
930	COLLMAJ	Char	2	2596	COLLEGE MAJOR BY TYPE
898	COMBAT	Num	8	2388	03, 08 AND 18
39	COMP80-94	Num	2	83	SERVICE COMPONENT
849	COMP_L	Num	2	2063	

#	Variable	Type	Len	Pos	Label
927	COMPRK	Num	8	2572	OVERALL CLASS STANDING AT TBS
931	COMPTHRD	Num	8	2598	OVERALL TBS PLACEMENT BY THIRD
43	CSVC80-94	Num	2	91	CHARACTER OF SERVICE
853	CSVC_L	Num	2	2071	
3	DDOC80-94	Num	3	6	DOD DUTY OCCUPATION CODE
813	DDOC_L	Num	3	1986	
19	DEPS80-94	Num	2	43	NUMBER OF DEPENDENTS
829	DEPS_L	Num	2	2023	
49	DMOS80-94	Char	7	108	DUTY MOS,AFSC,RATING/NEC
860	DMOS_L	Char	7	2090	
13	DOBDAY80-94	Num	2	31	DATE OF BIRTH - DAY
823	DOBDAY_L	Num	2	2011	
12	DOBMO80-94	Num	2	29	DATE OF BIRTH - MONTH
822	DOBMO_L	Num	2	2009	
11	DOBYR80-94	Num	2	27	DATE OF BIRTH - YEAR
821	DOBYR_L	Num	2	2007	
38	DOEMO80-94	Num	2	81	DATE OF ENTRY INTO OFFICER RANKS-MONTH
848	DOEMO_L	Num	2	2061	
37	DOEYR80-94	Num	2	79	DATE OF ENTRY INTO OFFICER RANKS-YEAR
847	DOEYR_L	Num	2	2059	
36	DORMO80-94	Num	2	77	DATE OF CURRENT RANK - MONTH
846	DORMO_L	Num	2	2057	
35	DORYR80-94	Num	2	75	DATE OF CURRENT RANK - YEAR
845	DORYR_L	Num	2	2055	
2	DPOC80-94	Num	3	3	DOD PRIMARY OCCUPATION CODE
812	DPOC_L	Num	3	1983	
4	DSOC80-94	Num	3	9	DOD SECONDARY OCCUPATION CODE
814	DSOC_L	Num	3	1989	
7	DUTLOC80-94	Num	3	18	DUTY LOCATION
817	DUTLOC_L	Num	3	1998	
17	EDCERT80-94	Num	2	39	EDUCATIONAL CERTIFICATION
827	EDCERT_L	Num	2	2019	
8	EDLEV80-94	Num	2	21	EDUCATION LEVEL
818	EDLEV_L	Num	2	2001	
21	ETH80-94	Num	2	47	ETHNIC GROUP
831	ETH_L	Num	2	2027	
34	ETSMO80-94	Num	2	73	ETS DATE - MONTH
844	ETSMO_L	Num	2	2053	
33	ETSYR80-94	Num	2	71	ETS DATE - YEAR
843	ETSYR_L	Num	2	2051	
896	FEMALE	Num	8	2372	
42	FS80-94	Num	2	89	FLYING STATUS
852	FS_L	Num	2	2069	
914	GCT	Num	8	2513	GENERAL CLASSIFICATION TEST SCORE
910	GRADED	Num	8	2484	ENTERED WITH GRADUATE LEVEL DEGREE
10	HOR80-94	Num	2	25	HOME OF RECORD
820	HOR_L	Num	2	2005	
20	HYEC80-94	Num	2	45	HIGHEST YEAR OF EDUCATION COMPLETED
830	HYEC_L	Num	2	2025	
5	ISC80-94	Num	3	12	INTER-SERVICE SEPARATION CODE

#	Variable	Type	Len	Pos	Label
815	ISC_L	Num	3	1992	
929	LEADRK	Num	8	2588	LEADERSHIP CLASS STANDING AT TBS
904	LEAVER	Num	8	2436	ANY OFFICER THAT LEFT THE COHORT
810	LOSSFLG	Num	2	1978	LOSS RECORD FLAG
897	MARRIED	Num	8	2380	MARITAL STATUS AS OF 1994 OR TIME OF SEP
6	MIG80-94	Num	3	15	MONTHS IN GRADE
816	MIG_L	Num	3	1995	
18	MS80-94	Num	2	41	MARITAL STATUS
828	MS_L	Num	2	2021	
29	MSETSD80-94	Num	2	63	ETS DAY OF MINIMUM SERVCE AGREEMENT
28	MSETSM80-94	Num	2	61	ETS MONTH OF MINIMUM SERVICE AGREEMENT
27	MSETSY80-94	Num	2	59	ETS YEAR OF MINIMUM SERVICE AGGREEMENT
906	NOCOLDEG	Num	8	2452	ENTERED WITHOUT A COLLEGE DEGREE
907	OBCOLDEG	Num	8	2460	ENTERED WITHOUT A COLLEGE DEGREE/OBTAINE
909	OBPGRAD	Num	8	2476	OBTAINED POSTGRADUATE DEGREE SINCE COMMI
41	OESC80-94	Num	2	87	OFFICER/ENLISTED SERVICE
851	OESC_L	Num	2	2067	
46	PEBDDY80-94	Num	2	97	PAY ENTRY BASE DATE - DAY
856	PEBDDY_L	Num	2	2077	
45	PEBDMO80-94	Num	2	95	PAY ENTRY BASE DATE - MONTH
855	PEBDMO_L	Num	2	2075	
44	PEBDYR80-94	Num	2	93	PAY ENTRY BASE DATE - YEAR
854	PEBDYR_L	Num	2	2073	
50	PEC80-94	Char	6	115	PROGRAM ELEMENT CODE
861	PEC_L	Char	6	2097	
9	PG80-94	Num	2	23	PAY GRADE
819	PG_L	Num	2	2003	
916	PG_SEP	Char	2	2526	PAY GRADE AT TIME OF SEPARATION
902	PILOTS	Num	8	2420	FIXED AND ROTARY-WING PILOTS AND NFOS
919	PME1	Char	3	2548	PROFESSIONAL MILITARY EDUCATION CODES
920	PME2	Char	3	2551	
921	PME3	Char	3	2554	
922	PME4	Char	3	2557	
923	PME5	Char	3	2560	
924	PME6	Char	3	2563	
925	PME7	Char	3	2566	
926	PME8	Char	3	2569	
48	PMOS80-94	Char	7	101	PRIMARY MOS,AFSC,RATING/NEC
859	PMOS_L	Char	7	2083	
915	POPGRP	Char	5	2521	EITHER WHITE/BLACK/HISPANIC/OTHER
903	PROMOTE	Num	8	2428	BINARY VARIABLE ONE IF PROMOTED TO MAJOR
15	RACE80-94	Num	2	35	RACE
825	RACE_L	Num	2	2015	
911	RESERVE	Num	8	2492	
22	RETH80-94	Num	2	49	RACE ETHNIC
832	RETH_L	Num	2	2029	
917	SEP_CODE	Char	4	2528	REASON FOR SEPARATION
839	SEPDAY_L	Num	2	2043	DATE OF SEPARATION - DAY
838	SEPMO_L	Num	2	2041	DATE OF SEPARATION - MONTH
837	SEPYR_L	Num	2	2039	DATE OF SEPARATION - YEAR

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  #  Variable    Type  Len   Pos  Label
-------------------------------------------------------------------
899  SERVICE     Num    8   2396  01, 34, 40, 43, 44, AND 58
 23  SEX80-94    Num    2     51  SEX
833  SEX_L       Num    2   2031
 16  SOC80-94    Num    2     37  SOURCE OF COMMISSION
826  SOC_L       Num    2   2017
913  SOURCE      Char   4   2509  SOURCE OF COMMISSION
 47  SPANSR80-94 Num    2     99  SPANISH SURNAME FLAG
857  SPANSR_L    Num    2   2079
879  SPD_L       Num    8   2236  SEPARATION PROGRAM DESIGNATOR
905  STAYPROM    Num    8   2444  ANY OFFICER THAT STAYED TO THE O-4 PROM
900  SUPPORT     Num    8   2404  02, 04, 13, 25, 26, 30 AND 35
858  SVC         Num    2   2081
 14  SVC80-94    Num    2     33  SERVICE
824  SVC_L       Num    2   2013
  1  TAFMS80-94  Num    3      0  TOTAL ACTIVE FEDERAL MILITARY SVC
811  TAFMS_L     Num    3   1980
864  UIC80-94    Char   8   2116  UNIT IDENTIFICATION CODE
880  UIC_L       Char   8   2244
651  UNTZIP80-94 Char   5    121  UNIT ZIP CODE
862  UNTZIP_L    Char   5   2103
 24  YOCS80-94   Num    2     53  YEAR OF COMMISSIONED SERVICE
834  YOCS_L      Num    2   2033
 40  YOS80-94    Num    2     85  YEARS OF ACTIVE DUTY SERVICE
850  YOS_L       Num    2   2065
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APPENDIX B. CORRELATION MATRICES FOR MULTIVARIATE MODELS

OBPGRAD SELECTION MODEL CORRELATION MATRIX

PEARSON CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 1087

	AVGPI	COMPRK	GCT	ROTC	ACADEMY	OCS	ENLCOM	MINORITY	FEMALE	MARRIED
AVGPI	1.00000	-0.32913	0.08147	0.08195	0.09258	-0.06544	0.03413	-0.10572	-0.02714	0.27626
	0.0000	0.0001	0.0072	0.0069	0.0022	0.0310	0.2609	0.0005	0.3714	0.0001
COMPRK	0.32913	1.00000	-0.20472	-0.04765	0.12736	-0.01047	-0.13882	0.20837	0.12784	-0.07821
	0.0001	0.0000	0.0001	0.1164	0.0001	0.7301	0.0001	0.0001	0.0001	0.0099
GCT	0.08147	-0.20472	1.00000	-0.05485	0.13571	-0.01984	0.08790	-0.10312	-0.01136	0.05288
	0.0072	0.0001	0.0000	0.0707	0.0001	0.5134	0.0037	0.0007	0.7083	0.0814
ROTC	0.08195	-0.04765	-0.05485	1.00000	-0.17191	-0.28291	-0.17364	0.00807	0.04190	0.03553
	0.0069	0.1164	0.0707	0.0000	0.0001	0.0001	0.0001	0.7904	0.1674	0.2418
ACADEMY	0.09258	0.12736	0.13571	-0.17191	1.00000	-0.18529	-0.11372	0.06448	-0.00515	0.08102
	0.0022	0.0001	0.0001	0.0001	0.0000	0.0001	0.0002	0.0335	0.8654	0.0075
OCS	0.06544	-0.01047	-0.01984	-0.28291	-0.18529	1.00000	-0.18715	-0.03492	0.07688	-0.11062
	0.0310	0.7301	0.5134	0.0001	0.0001	0.0000	0.0001	0.2500	0.0112	0.0003
ENLCOM	0.03413	-0.13882	0.08790	-0.17364	-0.11372	-0.18715	1.00000	0.04990	0.10593	0.01843
	0.2609	0.0001	0.0037	0.0001	0.0002	0.0001	0.0000	0.1001	0.0005	0.5438
MINORITY	0.10572	0.20837	-0.10312	0.00807	0.06448	-0.03492	0.04990	1.00000	0.02971	-0.04536
	0.0005	0.0001	0.0007	0.7904	0.0335	0.2500	0.1001	0.0000	0.3277	0.1350
FEMALE	0.02714	0.12784	-0.01136	0.04190	-0.00515	0.07688	0.10593	0.02971	1.00000	-0.10244
	0.3714	0.0001	0.7083	0.1674	0.8654	0.0112	0.0005	0.3277	0.0000	0.0007
MARRIED	0.27626	-0.07821	0.05288	0.03553	0.08102	-0.11062	0.01843	-0.04536	-0.10244	1.00000
	0.0001	0.0099	0.0814	0.2418	0.0075	0.0003	0.5438	0.1350	0.0007	0.0000

STAYPROM SELECTION MODEL CORRELATION MATRIX

PEARSON CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 1087

	AVGPI	COMPRK	OBPGRAD	COMBAT	SERVICE	SUPPORT	PILOTS	ROTC	ACADEMY	OCS
AVGPI	1.00000	-0.32913	0.15844	-0.02051	-0.01118	-0.13500	0.13811	0.08195	0.09258	-0.06544
	0.0000	0.0001	0.0001	0.4993	0.7127	0.0001	0.0001	0.0069	0.0022	0.0310
COMPRK	0.32913	1.00000	-0.08612	-0.04831	0.04275	0.08907	-0.05337	-0.04765	0.12736	-0.01047
	0.0001	0.0000	0.0045	0.1114	0.1590	0.0033	0.0786	0.1164	0.0001	0.7301
OBPGRAD	0.15844	-0.08612	1.00000	-0.05981	0.05179	0.04488	-0.00474	-0.04583	0.07218	0.05706
	0.0001	0.0045	0.0000	0.0487	0.0879	0.1392	0.8759	0.1311	0.0173	0.0600
COMBAT	0.02051	-0.04831	-0.05981	1.00000	-0.21180	-0.39434	-0.46452	0.06112	-0.09010	-0.04050
	0.4993	0.1114	0.0487	0.0000	0.0001	0.0001	0.0001	0.0439	0.0029	0.1822
SERVICE	0.01118	0.04275	0.05179	-0.21180	1.00000	-0.15794	-0.18605	0.04498	0.04997	-0.03127
	0.7127	0.1590	0.0879	0.0001	0.0000	0.0001	0.0001	0.1383	0.0996	0.3030
SUPPORT	0.13500	0.08907	0.04488	-0.39434	-0.15794	1.00000	-0.34638	0.00890	-0.09460	0.00147
	0.0001	0.0033	0.1392	0.0001	0.0001	0.0000	0.0001	0.7694	0.0018	0.9614
PILOTS	0.13811	-0.05337	-0.00474	-0.46452	-0.18605	-0.34638	1.00000	-0.10240	0.16893	0.05460
	0.0001	0.0786	0.8759	0.0001	0.0001	0.0001	0.0000	0.0007	0.0001	0.0720
ROTC	0.08195	-0.04765	-0.04583	0.06112	0.04498	0.00890	-0.10240	1.00000	-0.17191	-0.28291
	0.0069	0.1164	0.1311	0.0439	0.1383	0.7694	0.0007	0.0000	0.0001	0.0001
ACADEMY	0.09258	0.12736	0.07218	-0.09010	0.04997	-0.09460	0.16893	-0.17191	1.00000	-0.18529
	0.0022	0.0001	0.0173	0.0029	0.0996	0.0018	0.0001	0.0001	0.0000	0.0001
OCS	0.06544	-0.01047	0.05706	-0.04050	-0.03127	0.00147	0.05460	-0.28291	-0.18529	1.00000
	0.0310	0.7301	0.0600	0.1822	0.3030	0.9614	0.0720	0.0001	0.0001	0.0000
ENLCOM	0.03413	-0.13882	0.03474	0.00164	0.09290	0.04008	-0.14979	-0.17364	-0.11372	-0.18715
	0.2609	0.0001	0.2524	0.9568	0.0022	0.1867	0.0001	0.0001	0.0002	0.0001
RESERVE	0.16664	0.02191	-0.00575	0.02890	-0.04863	0.02753	-0.01775	-0.61574	-0.49950	0.37095
	0.0001	0.4705	0.8499	0.3412	0.1091	0.3646	0.5588	0.0001	0.0001	0.0001
AGE	0.01033	-0.11452	0.08417	-0.05371	0.04202	0.07604	-0.08075	-0.31283	-0.18819	0.31180
	0.7338	0.0002	0.0055	0.0767	0.1662	0.0122	0.0077	0.0001	0.0001	0.0001
MINORITY	0.10572	0.20837	0.01649	-0.02014	0.05211	0.07750	-0.09802	0.00807	0.06448	-0.03492
	0.0005	0.0001	0.5870	0.5072	0.0860	0.0106	0.0012	0.7904	0.0335	0.2500
FEMALE	0.02714	0.12784	0.06946	-0.16464	0.34774	0.11169	-0.14462	0.04190	-0.00515	0.07688
	0.3714	0.0001	0.0220	0.0001	0.0001	0.0002	0.0001	0.1674	0.8654	0.0112
MARRIED	0.27626	-0.07821	0.05852	-0.07392	0.01231	-0.02137	0.09300	0.03553	0.08102	-0.11062
	0.0001	0.0099	0.0537	0.0148	0.6853	0.4815	0.0021	0.2418	0.0075	0.0003
UNEMP	0.50901	0.19664	-0.24158	0.05803	0.03007	0.02660	-0.11073	-0.05523	-0.10563	0.09074
	0.0001	0.0001	0.0001	0.0558	0.3220	0.3810	0.0003	0.0687	0.0005	0.0028
MILLS1	0.11716	0.00000	0.97836	-0.03457	0.02741	0.05154	-0.01860	0.00000	-0.00000	-0.00000
	0.0001	1.0000	0.0001	0.2548	0.3667	0.0895	0.5402	1.0000	1.0000	1.0000

	ENLCOM	RESERVE	AGE	MINORITY	FEMALE	MARRIED	UNEMP	MILLS1
AVGPI	0.03413	-0.16664	-0.01033	-0.10572	-0.02714	0.27626	-0.50901	0.11716
	0.2609	0.0001	0.7338	0.0005	0.3714	0.0001	0.0001	0.0001
COMPRK	0.13882	0.02191	-0.11452	0.20837	0.12784	-0.07821	0.19664	0.00000
	0.0001	0.4705	0.0002	0.0001	0.0001	0.0099	0.0001	1.0000
OBPGRAD	0.03474	-0.00575	0.08417	0.01649	0.06946	0.05852	-0.24158	0.97836
	0.2524	0.8499	0.0055	0.5870	0.0220	0.0537	0.0001	0.0001
COMBAT	0.00164	0.02890	-0.05371	-0.02014	-0.16464	-0.07392	0.05803	-0.03457
	0.9568	0.3412	0.0767	0.5072	0.0001	0.0148	0.0558	0.2548
SERVICE	0.09290	-0.04863	0.04202	0.05211	0.34774	0.01231	0.03007	0.02741
	0.0022	0.1091	0.1662	0.0860	0.0001	0.6853	0.3220	0.3667
SUPPORT	0.04008	0.02753	0.07604	0.07750	0.11169	-0.02137	0.02660	0.05154
	0.1867	0.3646	0.0122	0.0106	0.0002	0.4815	0.3810	0.0895
PILOTS	0.14979	-0.01775	-0.08075	-0.09802	-0.14462	0.09300	-0.11073	-0.01860
	0.0001	0.5588	0.0077	0.0012	0.0001	0.0021	0.0003	0.5402
ROTC	0.17364	-0.61574	-0.31283	0.00807	0.04190	0.03553	-0.05523	0.00000
	0.0001	0.0001	0.0001	0.7904	0.1674	0.2418	0.0687	1.0000
ACADEMY	0.11372	-0.49950	-0.18819	0.06448	-0.00515	0.08102	-0.10563	-0.00000
	0.0002	0.0001	0.0001	0.0335	0.8654	0.0075	0.0005	1.0000
OCS	0.18715	0.37095	0.31180	-0.03492	0.07688	-0.11062	0.09074	-0.00000
	0.0001	0.0001	0.0001	0.2500	0.0112	0.0003	0.0028	1.0000
ENLCOM	1.00000	0.02501	0.45501	0.04990	0.10593	0.01843	-0.00913	-0.00000
	0.0000	0.4100	0.0001	0.1001	0.0005	0.5438	0.7637	1.0000
RESERVE	0.02501	1.00000	0.27190	-0.03985	-0.02325	-0.10388	0.12634	0.01922
	0.4100	0.0000	0.0001	0.1892	0.4437	0.0006	0.0001	0.5267
AGE	0.45501	0.27190	1.00000	0.00916	0.01550	0.00288	0.01509	0.04548
	0.0001	0.0001	0.0000	0.7630	0.6097	0.9244	0.6192	0.1340
MINORITY	0.04990	-0.03985	0.00916	1.00000	0.02971	-0.04536	0.06073	-0.00000
	0.1001	0.1892	0.7630	0.0000	0.3277	0.1350	0.0453	1.0000
FEMALE	0.10593	-0.02325	0.01550	0.02971	1.00000	-0.10244	0.08249	-0.00000
	0.0005	0.4437	0.6097	0.3277	0.0000	0.0007	0.0065	1.0000
MARRIED	0.01843	-0.10388	0.00288	-0.04536	-0.10244	1.00000	-0.29205	-0.00000
	0.5438	0.0006	0.9244	0.1350	0.0007	0.0000	0.0001	1.0000
UNEMP	0.00913	0.12634	0.01509	0.06073	0.08249	-0.29205	1.00000	-0.21419
	0.7637	0.0001	0.6192	0.0453	0.0065	0.0001	0.0000	0.0001
MILLS1	0.00000	0.01922	0.04548	-0.00000	-0.00000	-0.00000	-0.21419	1.00000
	1.0000	0.5267	0.1340	1.0000	1.0000	1.0000	0.0001	0.0000

PROMOTION MODEL CORRELATION MATRIX

PEARSON CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 455

	AVGPI	COMPRK	GCT	OBPGRAD	COMBAT	SERVICE	SUPPORT	PILOTS	ROTC	ACADEMY
AVGPI	1.00000	-0.22982	0.03258	0.05887	0.03681	-0.03463	-0.15087	0.10450	-0.01955	-0.03172
	0.0000	0.0001	0.4881	0.2101	0.4335	0.4611	0.0012	0.0258	0.6775	0.4997
COMPRK	0.22982	1.00000	-0.19371	-0.03985	-0.06926	0.05113	0.04431	0.00524	0.01694	0.18184
	0.0001	0.0000	0.0001	0.3964	0.1402	0.2764	0.3456	0.9112	0.7186	0.0001
GCT	0.03258	-0.19371	1.00000	0.01890	-0.07952	-0.05587	-0.00229	0.15277	-0.02150	0.15390
	0.4881	0.0001	0.0000	0.6877	0.0902	0.2342	0.9611	0.0011	0.6475	0.0010
OBPGRAD	0.05887	-0.03985	0.01890	1.00000	-0.10264	0.07399	0.06786	0.01317	-0.07640	0.05217
	0.2101	0.3964	0.6877	0.0000	0.0286	0.1150	0.1484	0.7794	0.1036	0.2668
COMBAT	0.03681	-0.06926	-0.07952	-0.10264	1.00000	-0.21487	-0.38503	-0.45988	0.10188	-0.10257
	0.4335	0.1402	0.0902	0.0286	0.0000	0.0001	0.0001	0.0001	0.0298	0.0287
SERVICE	0.03463	0.05113	-0.05587	0.07399	-0.21487	1.00000	-0.16329	-0.19504	0.01669	0.04443
	0.4611	0.2764	0.2342	0.1150	0.0001	0.0000	0.0005	0.0001	0.7226	0.3444
SUPPORT	0.15087	0.04431	-0.00229	0.06786	-0.38503	-0.16329	1.00000	-0.34950	0.00400	-0.16660
	0.0012	0.3456	0.9611	0.1484	0.0001	0.0005	0.0000	0.0001	0.9322	0.0004
PILOTS	0.10450	0.00524	0.15277	0.01317	-0.45988	-0.19504	-0.34950	1.00000	-0.11411	0.28352
	0.0258	0.9112	0.0011	0.7794	0.0001	0.0001	0.0001	0.0000	0.0149	0.0001
ROTC	0.01955	0.01694	-0.02150	-0.07640	0.10188	0.01669	0.00400	-0.11411	1.00000	-0.22085
	0.6775	0.7186	0.6475	0.1036	0.0298	0.7226	0.9322	0.0149	0.0000	0.0001
ACADEMY	0.03172	0.18184	0.15390	0.05217	-0.10257	0.04443	-0.16660	0.28352	-0.22085	1.00000
	0.4997	0.0001	0.0010	0.2668	0.0287	0.3444	0.0004	0.0001	0.0001	0.0000
OCS	0.03038	-0.05274	-0.01150	0.11831	-0.12286	0.02016	0.04040	0.06539	-0.26707	-0.18723
	0.5181	0.2616	0.8068	0.0116	0.0087	0.6680	0.3899	0.1638	0.0001	0.0001
ENLCOM	0.01319	-0.24983	0.07480	0.02462	0.03483	0.02754	0.06095	-0.18912	-0.21453	-0.15040
	0.7791	0.0001	0.1111	0.6004	0.4586	0.5580	0.1944	0.0001	0.0001	0.0013
RESERVE	0.05025	-0.05203	-0.13340	0.04181	0.01129	-0.00491	0.07378	-0.07096	-0.52693	-0.49541
	0.2848	0.2680	0.0044	0.3736	0.8101	0.9168	0.1161	0.1307	0.0001	0.0001
AGE	0.04242	-0.25011	0.04355	0.09858	-0.04069	0.00936	0.10897	-0.12759	-0.34854	-0.20898
	0.3666	0.0001	0.3540	0.0355	0.3865	0.8421	0.0201	0.0064	0.0001	0.0001
MINORITY	0.07750	0.12184	-0.02408	0.01583	-0.01559	0.03913	0.04299	-0.08305	-0.01198	0.08587
	0.0987	0.0093	0.6085	0.7363	0.7402	0.4050	0.3602	0.0768	0.7988	0.0672
FEMALE	0.13896	0.17138	-0.11417	0.07994	-0.14023	0.27563	0.08728	-0.12729	0.05233	-0.07752
	0.0030	0.0002	0.0148	0.0885	0.0027	0.0001	0.0629	0.0066	0.2653	0.0986
MARRIED	0.13234	0.02994	-0.00377	-0.04936	0.04009	-0.12872	-0.00516	0.03658	-0.04051	0.00997
	0.0047	0.5241	0.9360	0.2934	0.3936	0.0060	0.9125	0.4364	0.3886	0.8321
MILLS1	0.04841	0.03205	-0.00320	0.98459	-0.08778	0.06452	0.08066	-0.00427	-0.02161	-0.00686
	0.3029	0.4953	0.9458	0.0001	0.0613	0.1695	0.0857	0.9277	0.6457	0.8841
MILLS2	0.48988	0.17631	-0.04003	-0.21218	-0.03582	0.03368	-0.04764	0.06356	0.03296	-0.01039
	0.0001	0.0002	0.3943	0.0001	0.4459	0.4736	0.3106	0.1759	0.4831	0.8251

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	OCS	ENLCOM	RESERVE	AGE	MINORITY	FEMALE	MARRIED	MILLS1	MILLS2
AVGPI	0.03038	0.01319	0.05025	0.04242	-0.07750	-0.13896	0.13234	0.04841	-0.48988
	0.5181	0.7791	0.2848	0.3666	0.0987	0.0030	0.0047	0.3029	0.0001
COMPRK	0.05274	-0.24983	-0.05203	-0.25011	0.12184	0.17138	0.02994	0.03205	0.17631
	0.2616	0.0001	0.2680	0.0001	0.0093	0.0002	0.5241	0.4953	0.0002
GCT	0.01150	0.07480	-0.13340	0.04355	-0.02408	-0.11417	-0.00377	-0.00320	-0.04003
	0.8068	0.1111	0.0044	0.3540	0.6085	0.0148	0.9360	0.9458	0.3943
OBPGRAD	0.11831	0.02462	0.04181	0.09858	0.01583	0.07994	-0.04936	0.98459	-0.21218
	0.0116	0.6004	0.3736	0.0355	0.7363	0.0885	0.2934	0.0001	0.0001
COMBAT	0.12286	0.03483	0.01129	-0.04069	-0.01559	-0.14023	0.04009	-0.08778	-0.03582
	0.0087	0.4586	0.8101	0.3865	0.7402	0.0027	0.3936	0.0613	0.4459
SERVICE	0.02016	0.02754	-0.00491	0.00936	0.03913	0.27563	-0.12872	0.06452	0.03368
	0.6680	0.5580	0.9168	0.8421	0.4050	0.0001	0.0060	0.1695	0.4736
SUPPORT	0.04040	0.06095	0.07378	0.10897	0.04299	0.08728	-0.00516	0.08066	-0.04764
	0.3899	0.1944	0.1161	0.0201	0.3602	0.0629	0.9125	0.0857	0.3106
PILOTS	0.06539	-0.18912	-0.07096	-0.12759	-0.08305	-0.12729	0.03658	-0.00427	0.06356
	0.1638	0.0001	0.1307	0.0064	0.0768	0.0066	0.4364	0.9277	0.1759
ROTC	0.26707	-0.21453	-0.52693	-0.34854	-0.01198	0.05233	-0.04051	-0.02161	0.03296
	0.0001	0.0001	0.0001	0.0001	0.7988	0.2653	0.3886	0.6457	0.4831
ACADEMY	0.18723	-0.15040	-0.49541	-0.20898	0.08587	-0.07752	0.00997	-0.00686	-0.01039
	0.0001	0.0013	0.0001	0.0001	0.0672	0.0986	0.8321	0.8841	0.8251
OCS	1.00000	-0.18187	0.37793	0.26623	-0.03222	0.14521	-0.04589	0.06048	0.00526
	0.0000	0.0001	0.0001	0.0001	0.4930	0.0019	0.3287	0.1979	0.9109
ENLCOM	0.18187	1.00000	-0.00764	0.56132	0.00205	0.02894	-0.01728	-0.00705	-0.06245
	0.0001	0.0000	0.8708	0.0001	0.9652	0.5380	0.7131	0.8808	0.1836
RESERVE	0.37793	-0.00764	1.00000	0.23944	-0.02273	0.03750	0.03212	0.05568	-0.01678
	0.0001	0.8708	0.0000	0.0001	0.6287	0.4249	0.4943	0.2359	0.7211
AGE	0.26623	0.56132	0.23944	1.00000	-0.02915	0.04337	-0.01468	0.05722	-0.06993
	0.0001	0.0001	0.0001	0.0000	0.5352	0.3560	0.7548	0.2232	0.1364
MINORITY	0.03222	0.00205	-0.02273	-0.02915	1.00000	0.00744	0.02537	-0.00993	0.04595
	0.4930	0.9652	0.6287	0.5352	0.0000	0.8742	0.5894	0.8327	0.3281
FEMALE	0.14521	0.02894	0.03750	0.04337	0.00744	1.00000	-0.24367	0.04571	0.06916
	0.0019	0.5380	0.4249	0.3560	0.8742	0.0000	0.0001	0.3307	0.1408
MARRIED	0.04589	-0.01728	0.03212	-0.01468	0.02537	-0.24367	1.00000	-0.07609	-0.17756
	0.3287	0.7131	0.4943	0.7548	0.5894	0.0001	0.0000	0.1050	0.0001
MILLS1	0.06048	-0.00705	0.05568	0.05722	-0.00993	0.04571	-0.07609	1.00000	-0.19367
	0.1979	0.8808	0.2359	0.2232	0.8327	0.3307	0.1050	0.0000	0.0001
MILLS2	0.00526	-0.06245	-0.01678	-0.06993	0.04595	0.06916	-0.17756	-0.19367	1.00000
	0.9109	0.1836	0.7211	0.1364	0.3281	0.1408	0.0001	0.0001	0.0000

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